Technical Report HL-96-13
September 1996

US Army Corps of Engineers
Waterways Experiment Station

Navigation Lock for Bonneville Dam, Columbia River, Oregon

Volume I: Main Text

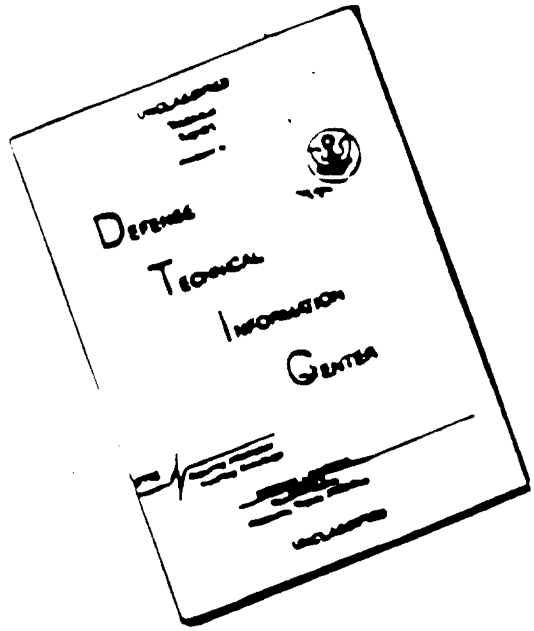
by Richard L. Stockstill, John F. George

19961118 170

Approved For Public Release; Distribution Is Unlimited

Prepared for U.S. Army Engineer District, Portland

DISCLAIMER NOTICE



THIS DOCUMENT IS BEST QUALITY AVAILABLE. THE COPY FURNISHED TO DTIC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

Technical Report HL-96-13
September 1996

Navigation Lock for Bonneville Dam, Columbia River, Oregon

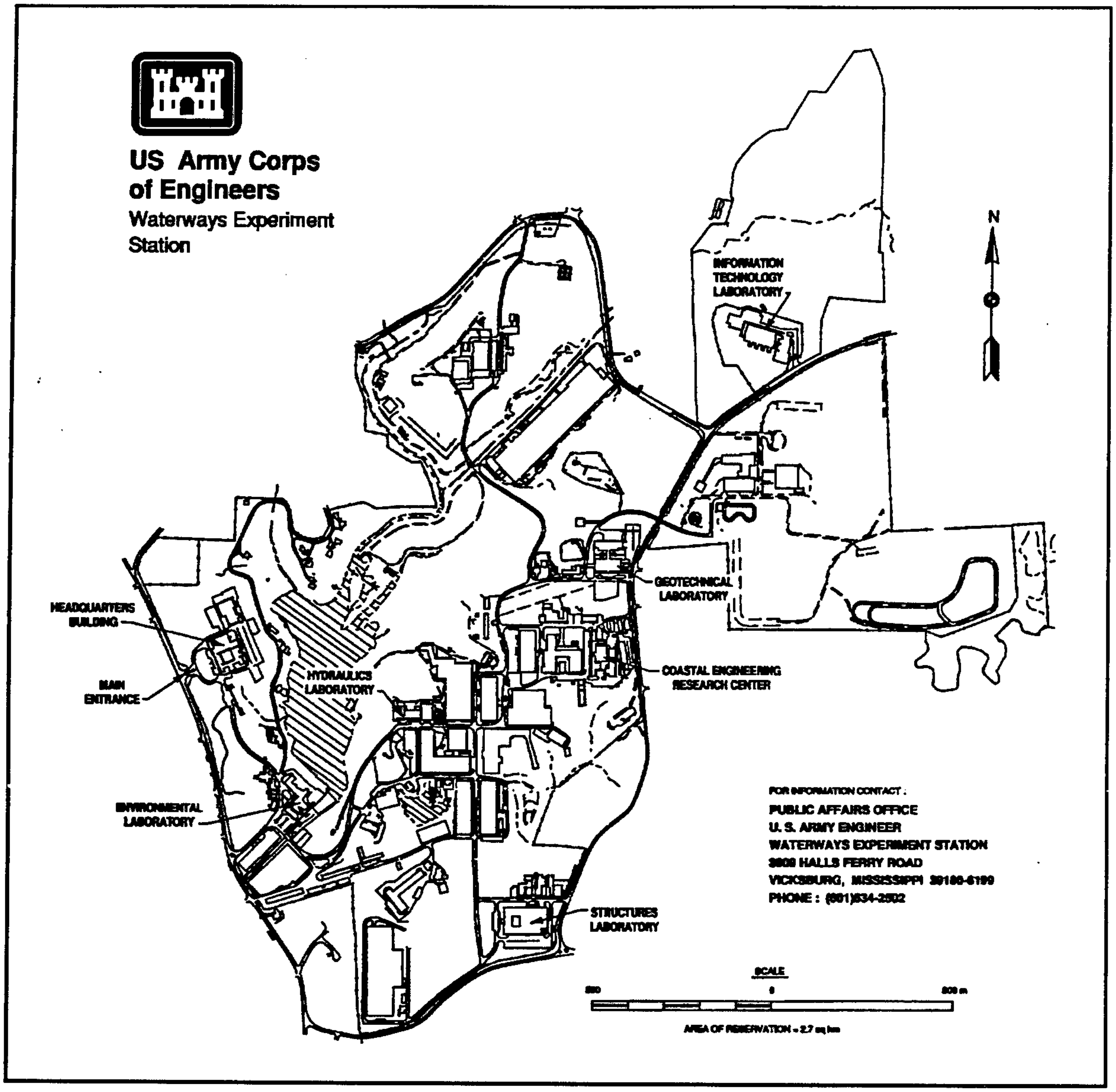
Volume I: Main Text

by Richard L. Stockstill, John F. George

U.S. Army Corps of Engineers
Waterways Experiment Station
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

Final report

Prepared for U.S. Army Engineer District, Portland
Portland, OR 97208-2946



Waterways Experiment Station Cataloging-in-Publication Data

Stockstill, Richard L.

Navigation lock for Bonneville Dam, Columbia River, Oregon / by Richard L. Stockstill, John F. George ; prepared for U.S. Army Engineer District, Portland.

2 v. : ill. ; 28 cm. — (Technical report ; HL-96-13)

Includes bibliographical references.

v. 1. Main text—v. 2. Appendix A, pressures during lock operations.

1. Bonneville Dam (Or. and Wash.) 2. Locks (Hydraulic engineering) — Oregon —Columbia River. 3. Hydraulic models — Oregon — Columbia River. 4. Columbia River. I. George, John F. II. United States. Army. Corps of Engineers. Portland District. III. U.S. Army Engineer Waterways Experiment Station. IV. Hydraulics Laboratory (U.S. Army Engineer Waterways Experiment Station) V. Title. VI. Series: Technical report (U.S. Army Engineer Waterways Experiment Station) ; HL-96-13.

TA7 W34 no.HL-96-13

Contents

[1] A limited number of copies of Appendix A were published under separate cover. Copies are available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

Preface

The first model investigation reported herein was authorized by the Headquarters, U.S. Army Corps of Engineers, on 26 August 1982 at the request of the U.S. Army Engineer District, Portland. A second investigation of a completely different design was authorized on 27 December 1985 as a result of a value engineering study.

The studies were conducted during the period August 1982 to March 1989 in the Hydraulics Laboratory (HL) of the U. S. Army Engineer Waterways Experiment Station (WES) under the direction of Messrs. F. A. Herrmann, Jr., Director, HL, and R. A. Sager, Assistant Director, HL; and under the general supervision of Messrs. G. A. Pickering, Chief, Hydraulic Structures Division (HSD), HL, and J. F. George, Chief, Locks and Conduits Branch, HSD. Hydraulic consultation was provided by Dr. F. M. Neilson, Hydraulic Engineering Analysis Center, HSD. Tests were conducted by Messrs. George, R. L. Stockstill, C. L. Dent, V. E. Stewart, and M. W. Ott, all of the Locks and Conduits Branch. The report was prepared by Messrs. Stockstill and George.

The model components were constructed and assembled by Messrs. E. B. Williams, W. R. Landers, M. A. Simmons, and J. A. Lyons of the Model Shop, Engineering and Construction Services Division, WES, under the supervision of Mr. Sidney J. Leist, Chief of the Model Shop.

Messrs. Bill Branch, Floyd Hall, Ted Edmister, and Jim Stow of the Portland District, and Mr. Bruce McCartney of Headquarters, U.S. Army Corps of Engineers, visited WES during the course of the model study to observe model operation and correlate results with concurrent design works.

At the time of publication of this report, Director of WES was Dr. Robert W. Whalin. Commander was COL Bruce K. Howard, EN.

Conversion Factors, Non-SI to SI Units of Measurement

Non-SI units of measurement used in this report can be converted to SI units as follows:

Multiply	By	To Obtain
cubic feet	0.02831685	cubic meters
degrees (angle)	0.01745329	radians
feet	0.3048	meters
miles (U.S. statute)	1.609347	kilometers
square feet	0.09290304	square meters
tons (force)	8,896.443	newtons

1 Introduction

The Prototype

The Bonneville Project is located on the Columbia River at the head of tidewater, 146 miles[1] above the mouth and 42 miles east of Portland, OR (Figure 1). The new navigation lock was constructed adjacent to the south side of the existing lock along the shore. The lock coordinates at station 30+00 are N 721,645.00, E 1,629,535.00, with stationing increasing along the lock center line in the downstream direction.

Description of Structures

The principal structures of the Bonneville Project consist of a spillway dam, an existing navigation lock, the First Powerhouse, the Second Powerhouse, and a new navigation lock.

a. Spillway dam. The concrete gravity dam has an ogee crest and is gate controlled. The overall length of the dam is 1,450 ft. Closure of the dam was conducted in September 1937.

b. Existing lock. The existing lock, which began service in January 1938, has chamber dimensions of 76 ft wide by 500 ft long. The lock filling and emptying system consists of a 14-ft-diameter longitudinal main culvert and forty-one 4-ft-diameter filling and emptying ports.

c. First Powerhouse. The First Powerhouse is 1,027 ft long by 190 ft wide. It includes 10 hydrogenerating units that result in a total rated capacity of 518,400 kW. Installation of all 10 units was completed in December 1943.

[1] A table of factors for converting non-SI units of measurement to SI units is found on page vi.

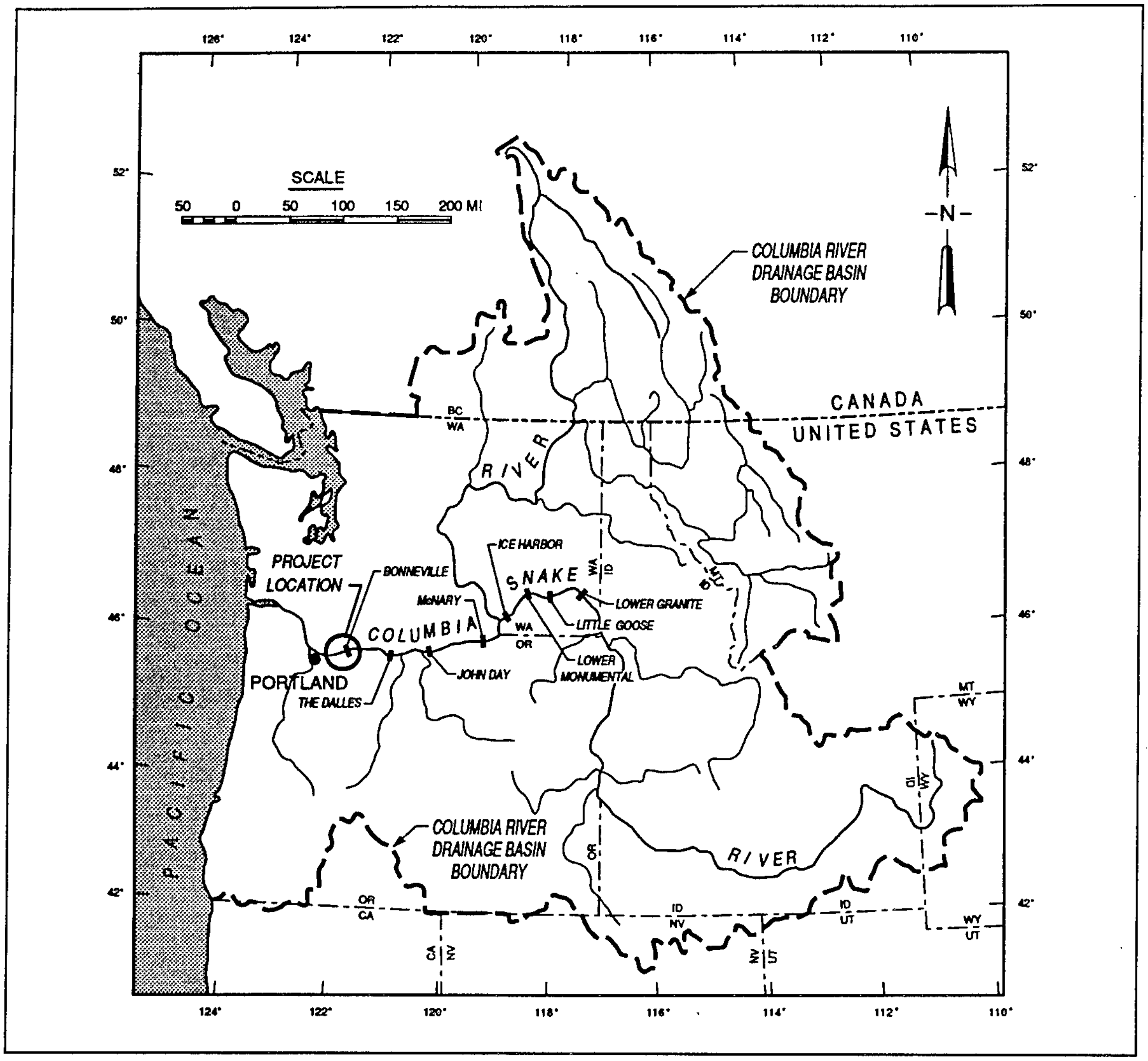


Figure 1. Vicinity map

d. Second Powerhouse. Installation of the Second Powerhouse was completed in October 1982. This powerhouse has a length of 985.5 ft and a width of 221.25 ft and has a total rated capacity of 558 MW.

e. New lock. The new lock has chamber dimensions of 86 ft wide by 675 ft long. The upstream and downstream guide walls are 940 and 950 ft in length, respectively. The upper sill has a top elevation of 51[1] and the lower sill has a top elevation of -12. The project has a design draft for loaded vessels of 14 ft.

---

[1] All elevations (el) and stages cited herein are in feet referred to the National Geodetic Vertical Datum (NGVD).

The Bonneville Project can have a normal pool fluctuation between el 71.5 and el 76.5. The pool has been operated at an elevation as high as el 82.5 and as low as el 70.0. The model study included the extreme pool of el 82.5. El 76.5 was established as the design pool for the model study. Since Bonneville is the lowermost dam on the Columbia River, a wide range of tailwaters can be expected. A minimum tailwater of el 7.0 was used for design, but since degradation of the downstream channel may occur, lower tailwater elevations were also tested. A combination of pool el 76.5 and tailwater el 7.0 resulted in a design lift of 69.5 ft.

Purpose and Scope of Study

A model testing program was conducted because the current design procedure and analytical techniques are insufficient for a project of this complexity since the prime objective of the project is to provide safe, reliable, and rapid navigation. Because of the high lift (69.5 ft) involved, model studies were needed to ensure the adequacy of the various elements of the system; that no undesirable hydraulic conditions exist; and that the proposed system will provide a safe means for filling and emptying the lock.

Specifically, the model study was to determine

a. Filling and emptying times for various valve speeds and initial heads.

b. Flow conditions and motion characteristics of unmoored barges in the lock chamber during filling and emptying operations.

c. Hawser forces exerted on barges moored in the lock chamber.

d. Pressures in the culverts.

e. Vortex tendencies at the intake vicinity.

2 Physical Models

Description

Studies were conducted with two different 1:25-scale models of bottom longitudinal filling and emptying systems. The first filling and emptying system tested was similar to the design used on the Lower Granite Lock (U.S. Army Engineer Division, North Pacific, 1979). This system, which consisted of eight longitudinal floor culverts, for the purposes of this report will be defined as the H-H pattern system (Figure 2).

Toward the end of the model study of the H-H pattern system, a Value Engineering (VE) study suggested that a filling and emptying system similar to the design used on Bay Springs Lock (Ables 1978) would be more economical for the new lock. The design suggested by the VE study consisted of four longitudinal floor culverts rather than eight (Figure 3). This filling and emptying system was defined as the H pattern system for purposes of this report.

This report presents the results of the two separate model studies conducted. One model study was of the hydraulic characteristics of the H-H pattern filling and emptying system, and the second model study was of the hydraulic characteristics of the H pattern system.

H-H Pattern System

The 1:25-scale model reproduced approximately 800 ft of the upstream approach (Figure 4), the filling and emptying system including portions of the upper guide and guard walls, intakes, valves and culverts, floor culverts (Figure 2), lower guide and guard walls, and approximately 700 ft of downstream approach (Figure 5). The approach areas and the lock chamber were constructed of plywood; and the intakes, valve wells, culverts, and discharge outlets were constructed of plastic. The culvert valves were constructed of sheet metal and fitted with seals to prevent leakage. Six sheet-metal barges, each simulating a length of 220 ft and width of 42 ft, were loaded with weights to reproduce the desired 14-ft draft.

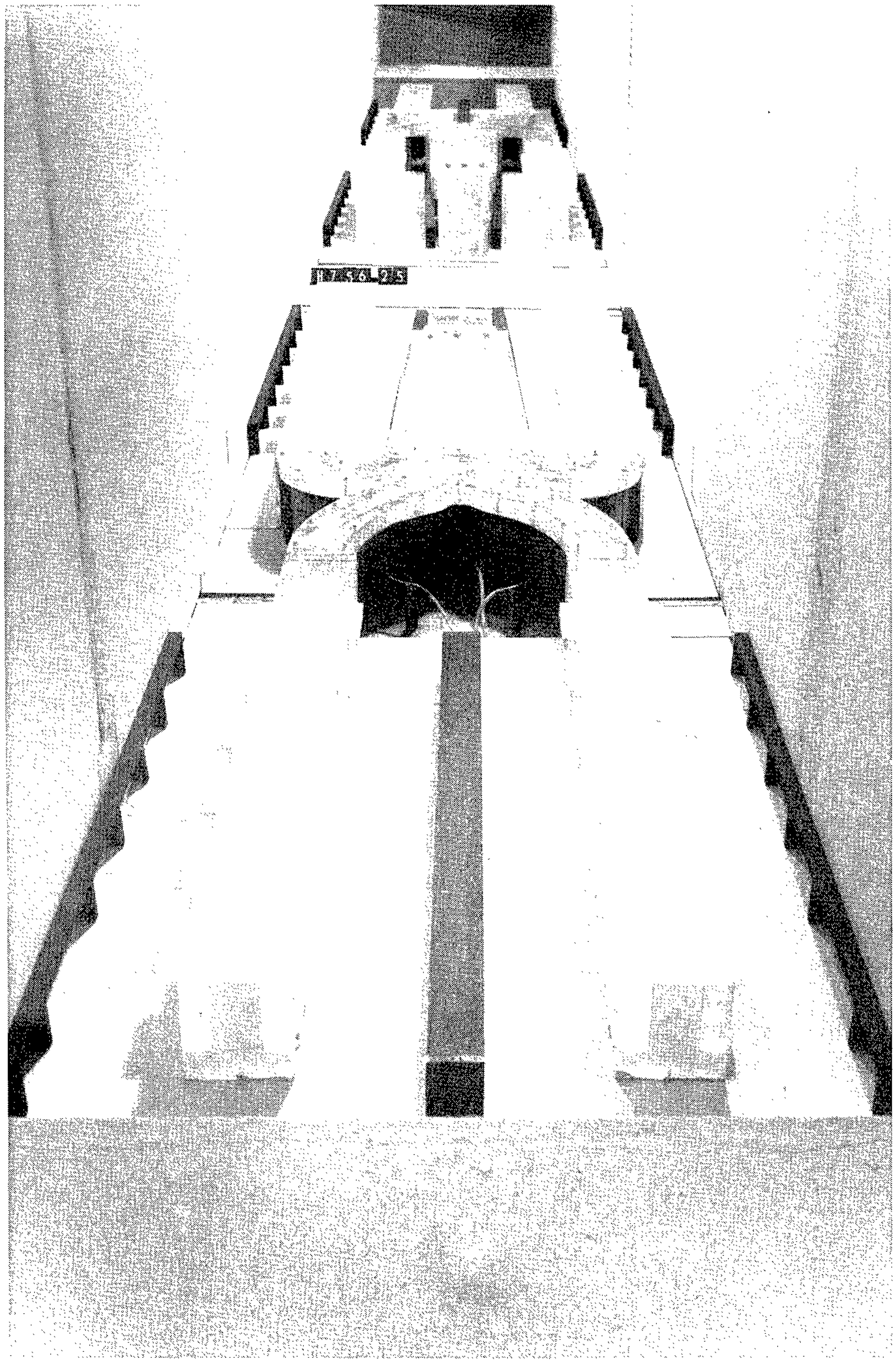


Figure 2. H-H pattern system, type 1 (original) design looking upstream

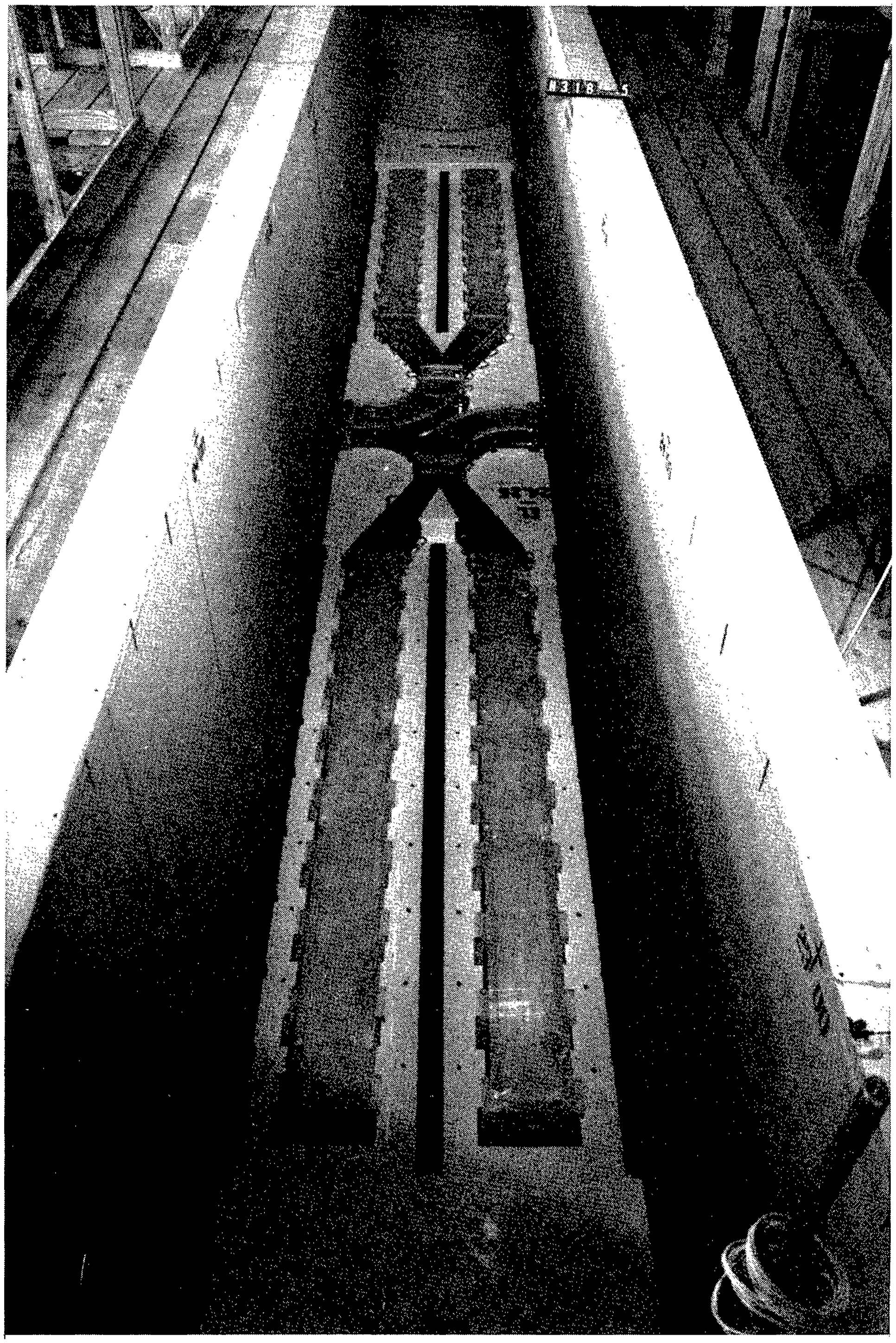


Figure 3. H pattern system, type 1 (original) design looking downstream

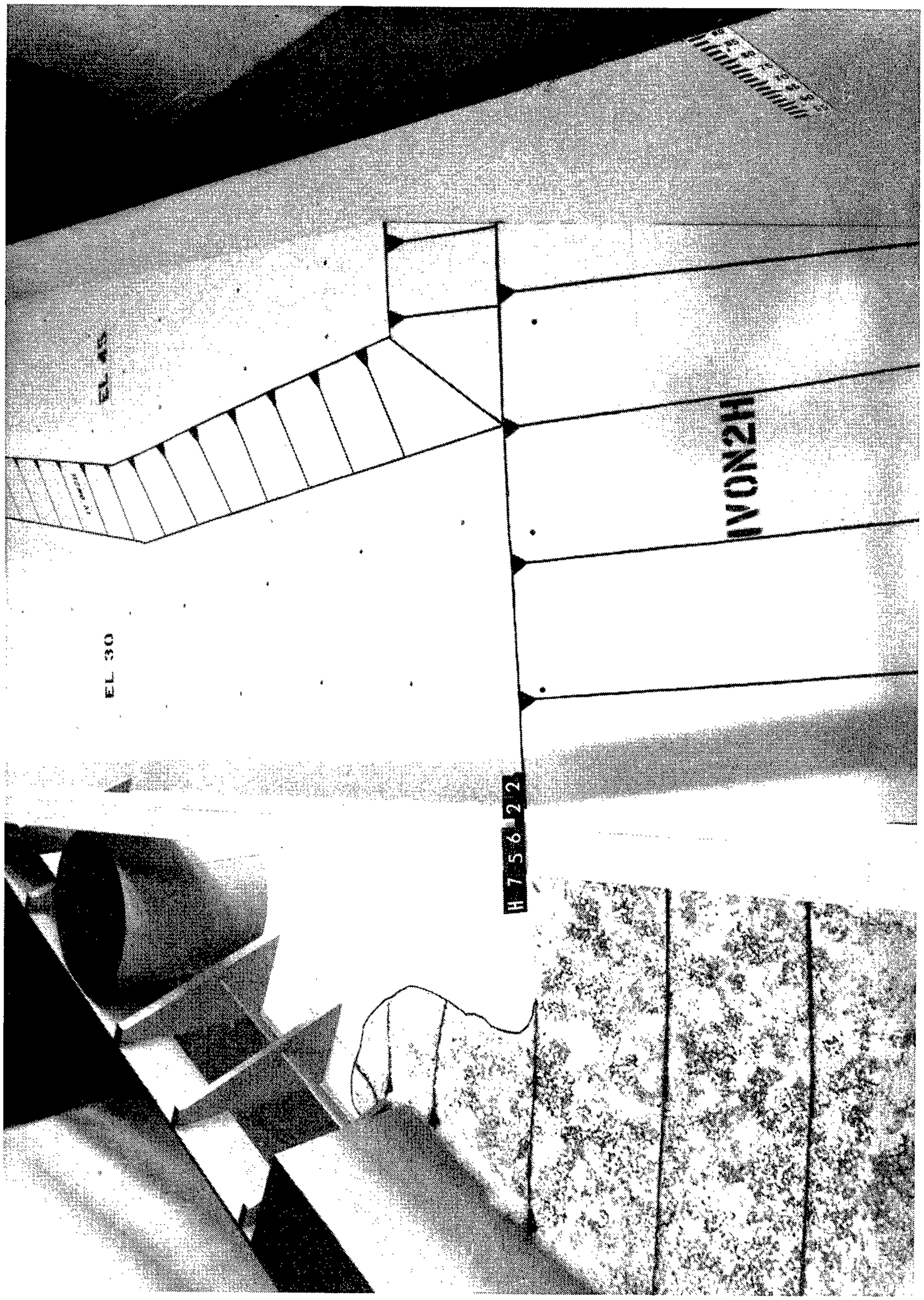


Figure 4. H-H pattern system, upstream lock approach, type 1 (original) design, looking upstream

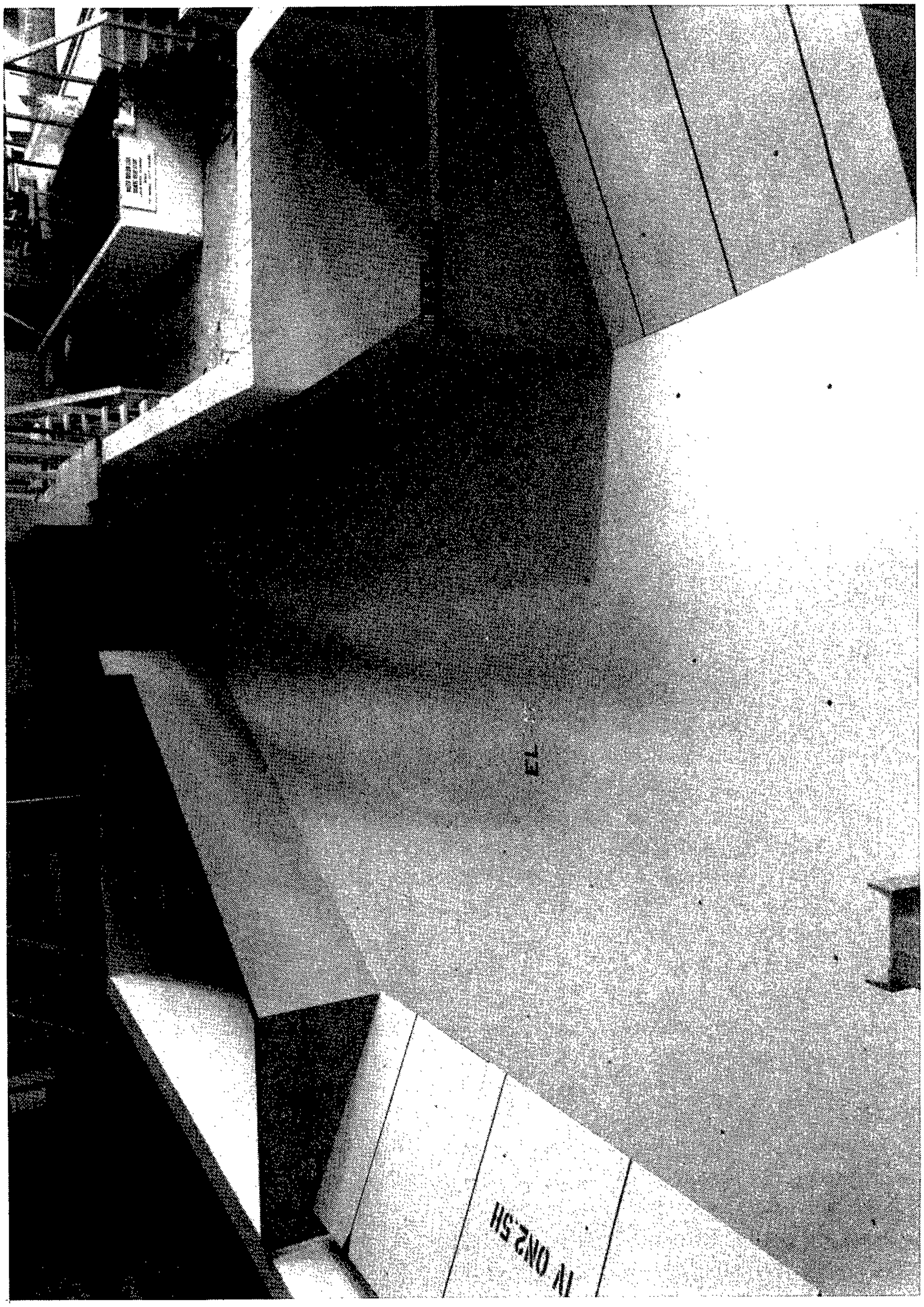


Figure 5. H-H pattern system, downstream lock approach, type 1 (original) design, looking upstream

H Pattern System

The 1:25-scale lock model reproduced 700 ft of the upstream approach, the entire filling and emptying system including portions of the upper guide and guard walls (Figure 6), intakes, valves and culverts, floor culvert system (Figure 3), outlets, the lock chamber, lower guide and guard walls, and about 700 ft of downstream approach (Figure 7). The approach areas and the lock chamber were also constructed of plywood; and the intakes, valve wells, culverts, and outlets were constructed of plastic. The culvert valves were constructed of sheet metal and fitted with rubber seals to prevent leakage.

Appurtenances and Instrumentation

Water was supplied to the models through a circulating system. Both headbay and tailbay contained skimming weirs that maintained essentially constant upper and lower pools during filling and emptying operations. Vertical adjustments of the skimming weirs permitted simulation of any desired upper and lower pool elevations. Dye and confetti were used to study subsurface and surface current directions. Pressure cells were used to measure instantaneous pressures and to record water surface in the lock chamber.

The movement of culvert valves was controlled by servo-driven linear actuators that were regulated by the output of a microcomputer. Programming of the microcomputer resulted in varied output such that the desired valve schedule could be reproduced. The valve opening schedule used in the tests is shown in Plate 1.

A hawser-pull (force links) device used for measuring the longitudinal and transverse forces acting on a tow in the lock chamber during filling and emptying operations is shown in Figure 8. Three such devices were used: one measured longitudinal forces and the other two measured transverse forces on the downstream and upstream ends of the tow, respectively. These links were machined from aluminum and had SR-4 strain gages cemented to the inner and outer edges. When the device was mounted on the tow, one end of the link was pin-connected to the tow while the other end was engaged to a fixed vertical rod. While connected to the tow the link was free to move up and down with changes in the water-surface elevation in the lock. Any horizontal motion of the tow caused the links to deform and vary the signal to a recorder. The links were calibrated by inducing deflection with known weights.

All data obtained from the pressure cells used to measure instantaneous pressures and data obtained from the strain gages used to measure hawser forces were recorded graphically on a commercial recorder. The sensing elements (mechanical to electrical conversion devices) associated with these data were connected from various points on the model to amplifiers where the outputs were stepped up to the level required for graphical recording.

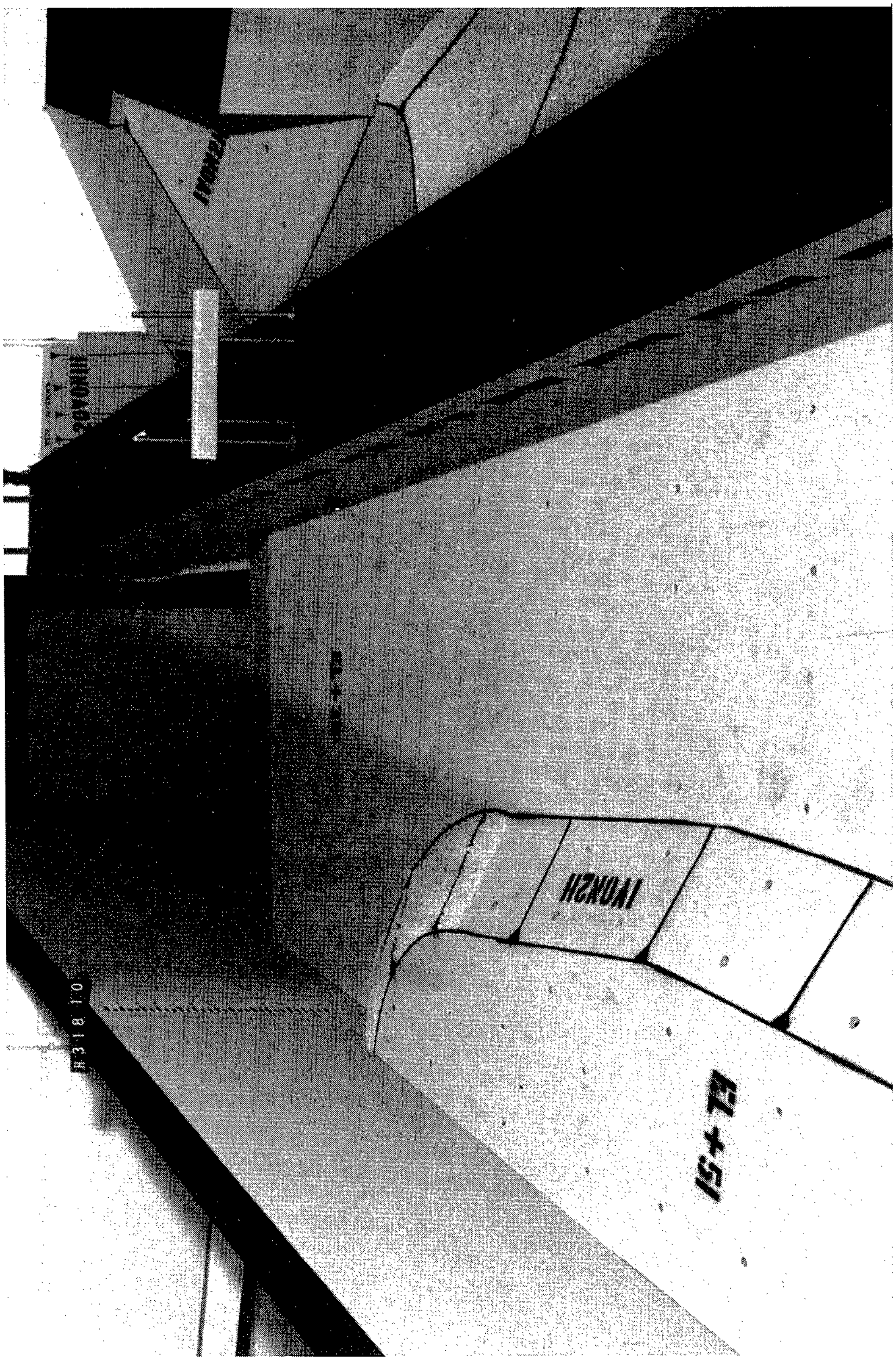


Figure 6. H pattern system, upstream lock approach, type 1 (original) design

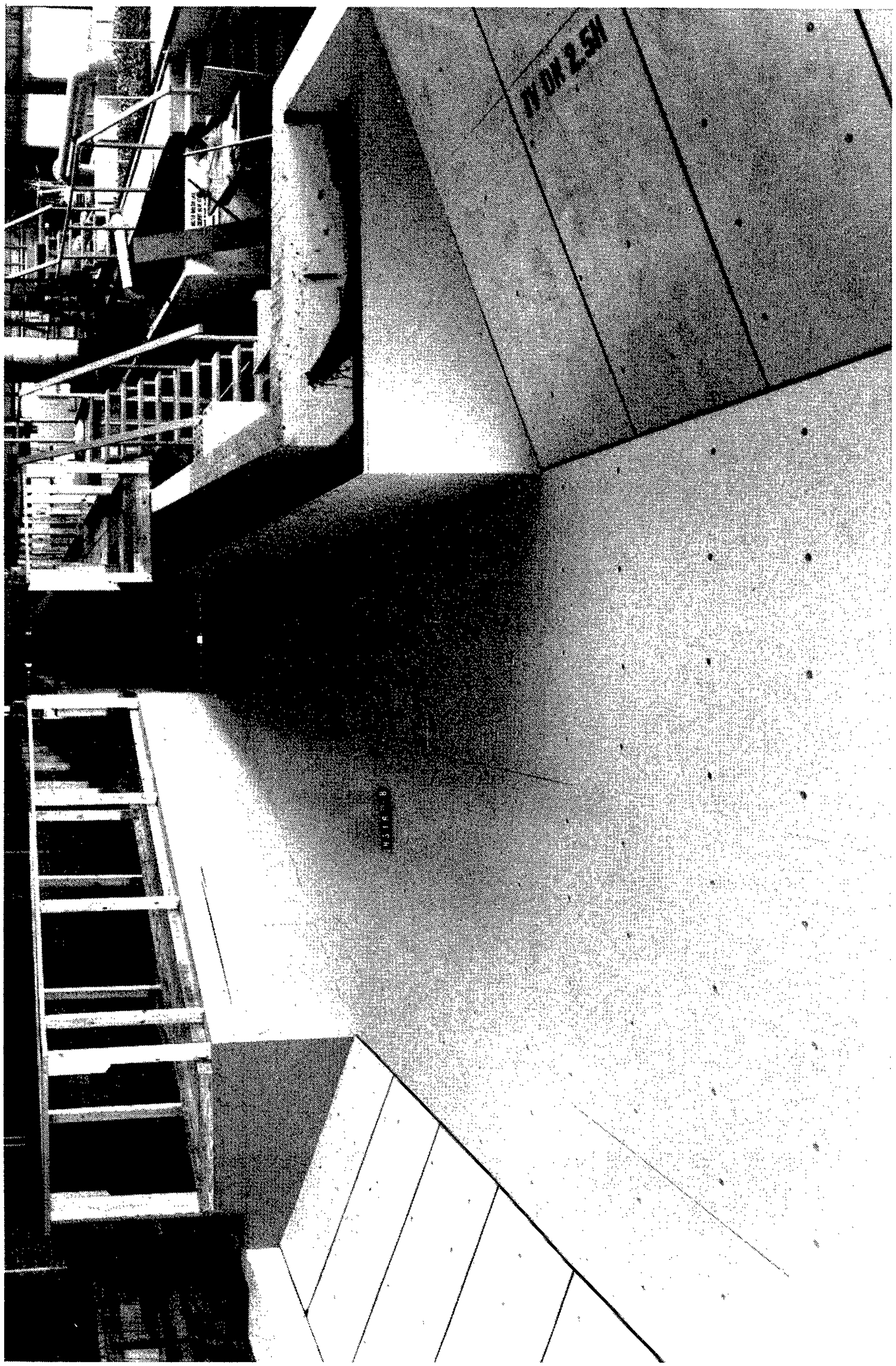


Figure 7. H pattern system, downstream lock approach

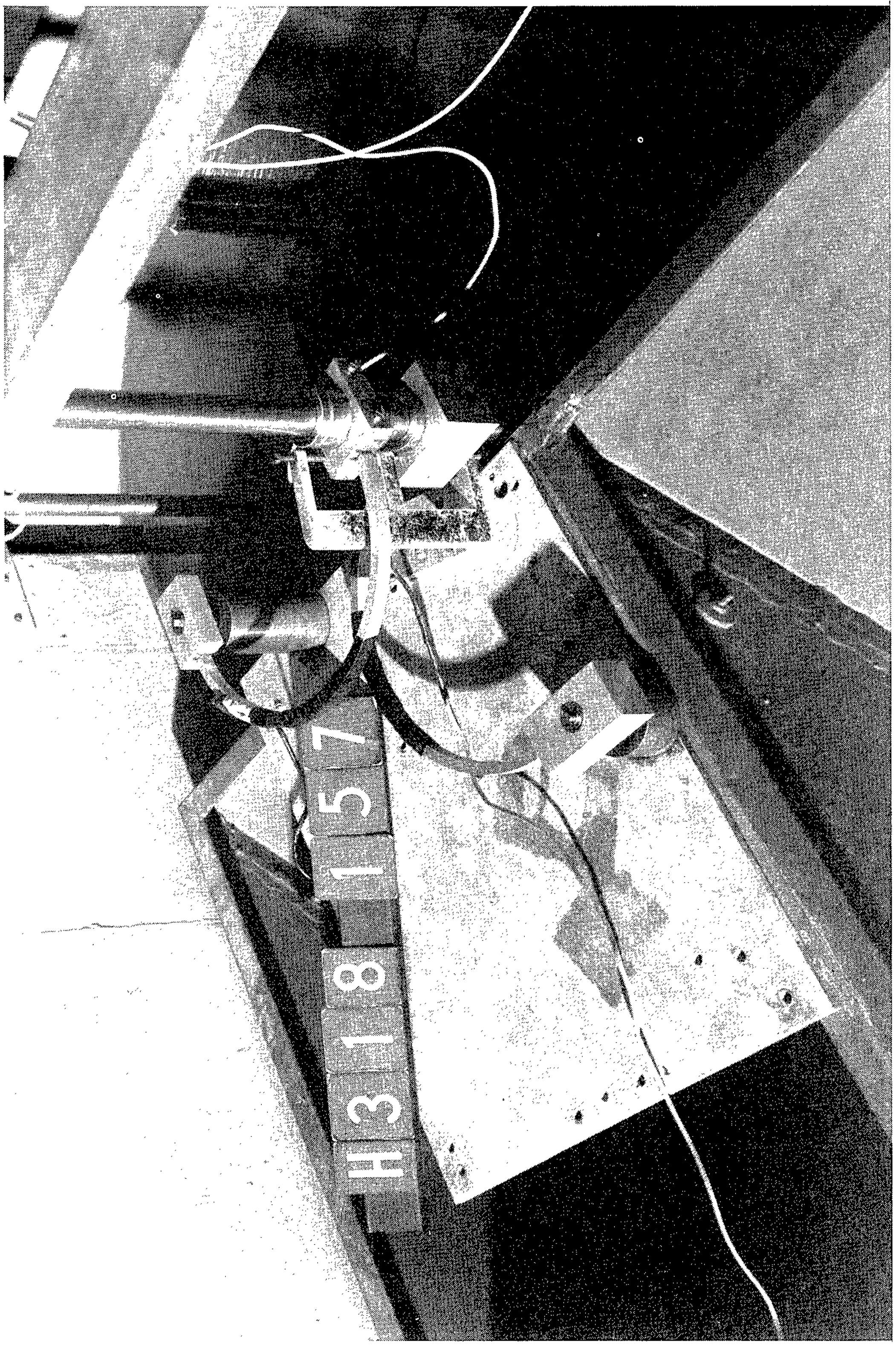


Figure 8. Hawser-pull (force links) measuring device

Pressures throughout the systems were measured with piezometers connected to pressure cells by the use of tubing (Figure 9). Electrical outputs from these pressure cells were digitized by means of commercial analog to digital boards installed in a personal computer. Software was then used to compute pressures from digital input. Pressures obtained in this manner are average pressures because of the reduction in frequency response resulting from the use of tubing.

Scale Relations

The accepted equations of hydraulic similitude, based on the Froudian relations, were used to express mathematical relations between the dimensions and hydraulic quantities of the model and prototype. General relations for the transfer of the model data to prototype equivalents, or vice versa, are presented in the following tabulation:

Characteristic	Dimension[1]	Scale Relation Model:Prototype
Length	$L_r = L$	1:25
Pressure	$P_r = L_r$	1:25
Area	$A_r = L_r^2$	1:625
Velocity	$V_r = L_r^{1/2}$	1:5
Discharge	$Q_r = L_r^{5/2}$	1:3,125
Time	$T_r = L_r^{1/2}$	1:5
Force	$F_r = L_r^3$	1:15,625

[1]Dimensions are in terms of length.

Test Procedures

Evaluation of the various elements of the system was based on data obtained during typical filling and emptying operations. Performance was based primarily on hawser forces on tows in lockage, movement of unmoored (free) tows in the lock chamber, turbulence, pressures, and time required for filling and emptying. In determination of approach and exit flow conditions, fixed-head (steady flow) conditions were used with the culvert valve and/or miter gates fully opened or closed.

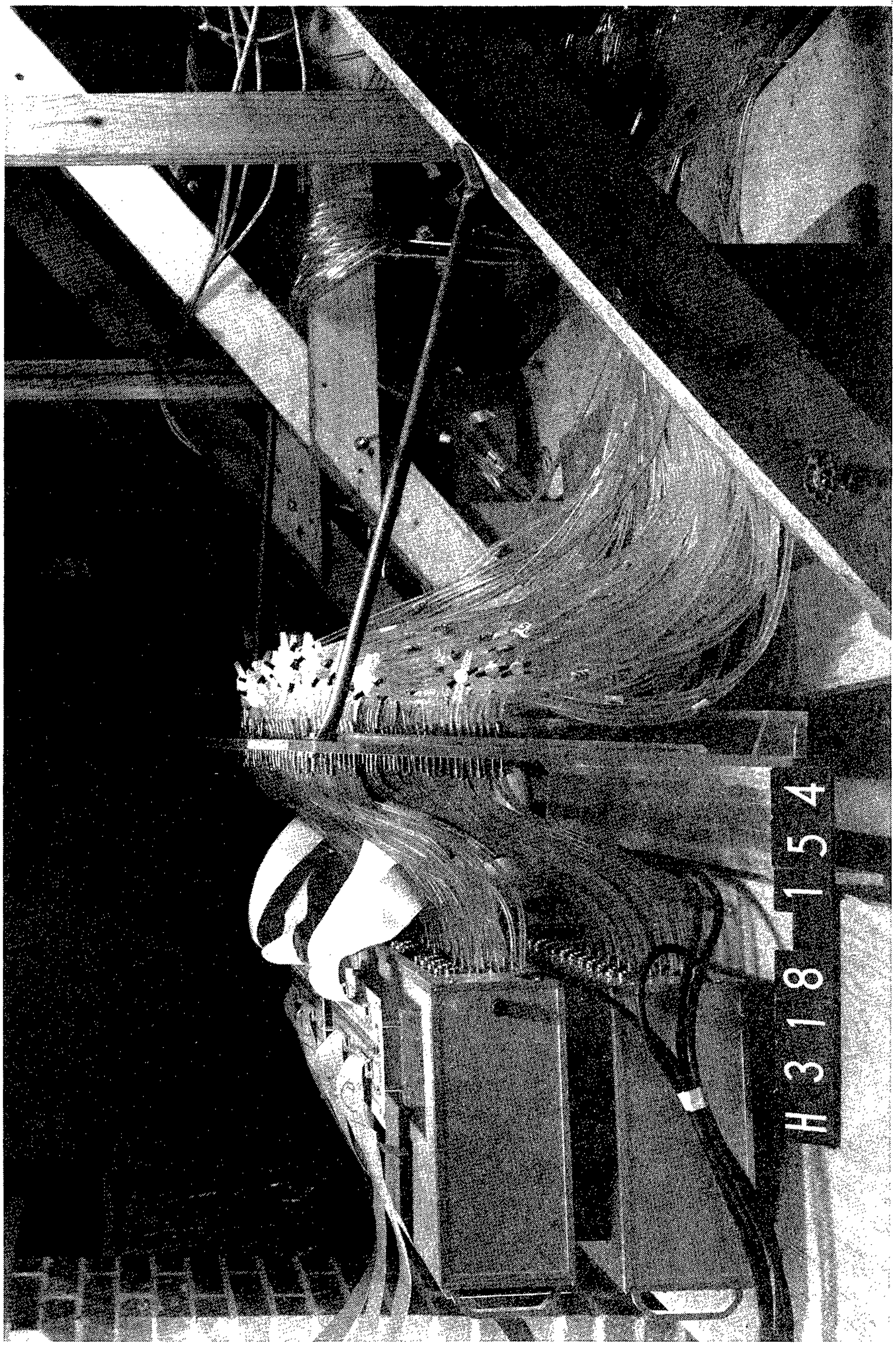


Figure 9. Piezometer to pressure cell setup

3 Tests and Results

H-H Pattern System

The original design filling and emptying system (Plate 2) was very similar to the Lower Granite Lock filling and emptying system in that it used a bottom longitudinal system incorporating eight longitudinal floor culverts symmetrically placed around the center of the lock chamber. One of the main differences between this system and the H pattern system is that a significant portion of the filling and emptying culverts and the crossover were located beneath the floor of the lock chamber. This resulted in the curves in the crossover culvert having very short radii. The primary elements of this system consist of two intake manifolds each having four 8-ft-wide by 30-ft-high ports leading into 12-ft-wide by 14-ft-high culverts; filling valves the same size as the culverts; culverts that transitioned to 12-ft-wide by 22-ft-high filling culverts; a crossover culvert with a horizontal splitter wall in each main culvert to divide flows into each half of the lock chamber in conjunction with two splitter manifolds leading to the eight longitudinal floor culvert manifolds; emptying culverts that were 12 ft wide by 14 ft high; emptying valves the same size as the culverts; and two discharge laterals interlaced to spread the flow in the exit channel.

Upstream approach and intakes

Initially, average pressures were measured in several critical areas of the filling and emptying system with single valve operations and a 69.5-ft lift for preliminary evaluation of the proposed system. These data indicated no severe negative pressures existed. Modifications to the approach channel and relocation of the lock intakes were made as requested by the U.S. Army Engineer District, Portland, for foundation interests. This was designated the type 2 design filling and emptying system and is shown in Figures 10-13 and Plate 3. The tops of the intakes were lowered from el 20.0 to el -23.0 in the type 2 design (Plate 4), where they remained for the duration of this investigation. The roof of the intake manifolds provided 93.0 ft and 99.5 ft of submergence for minimum and maximum pool elevations of 70.0 and 76.5, respectively.

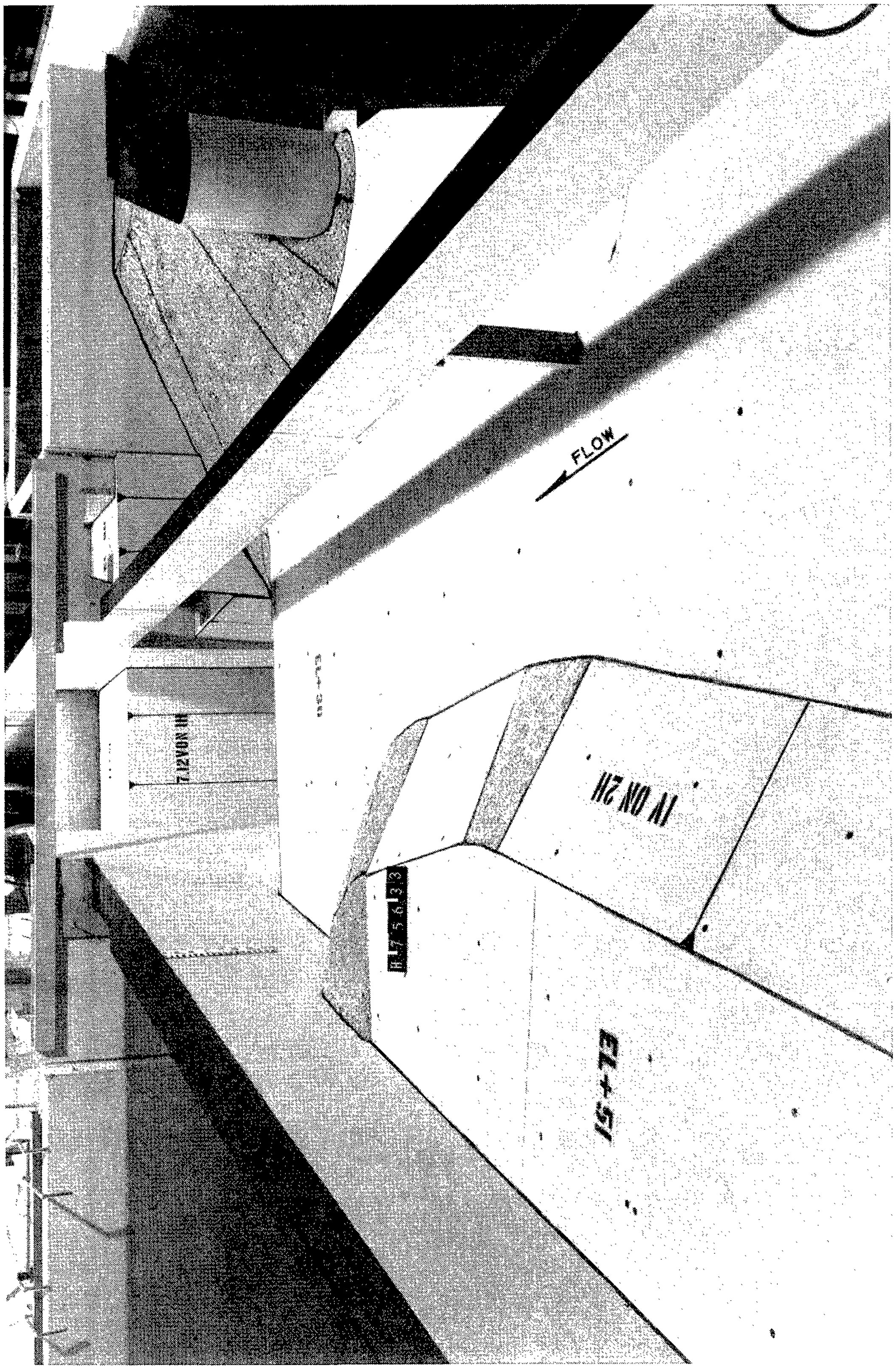


Figure 10. Upstream lock approach, type 2 design H-H pattern system, looking downstream

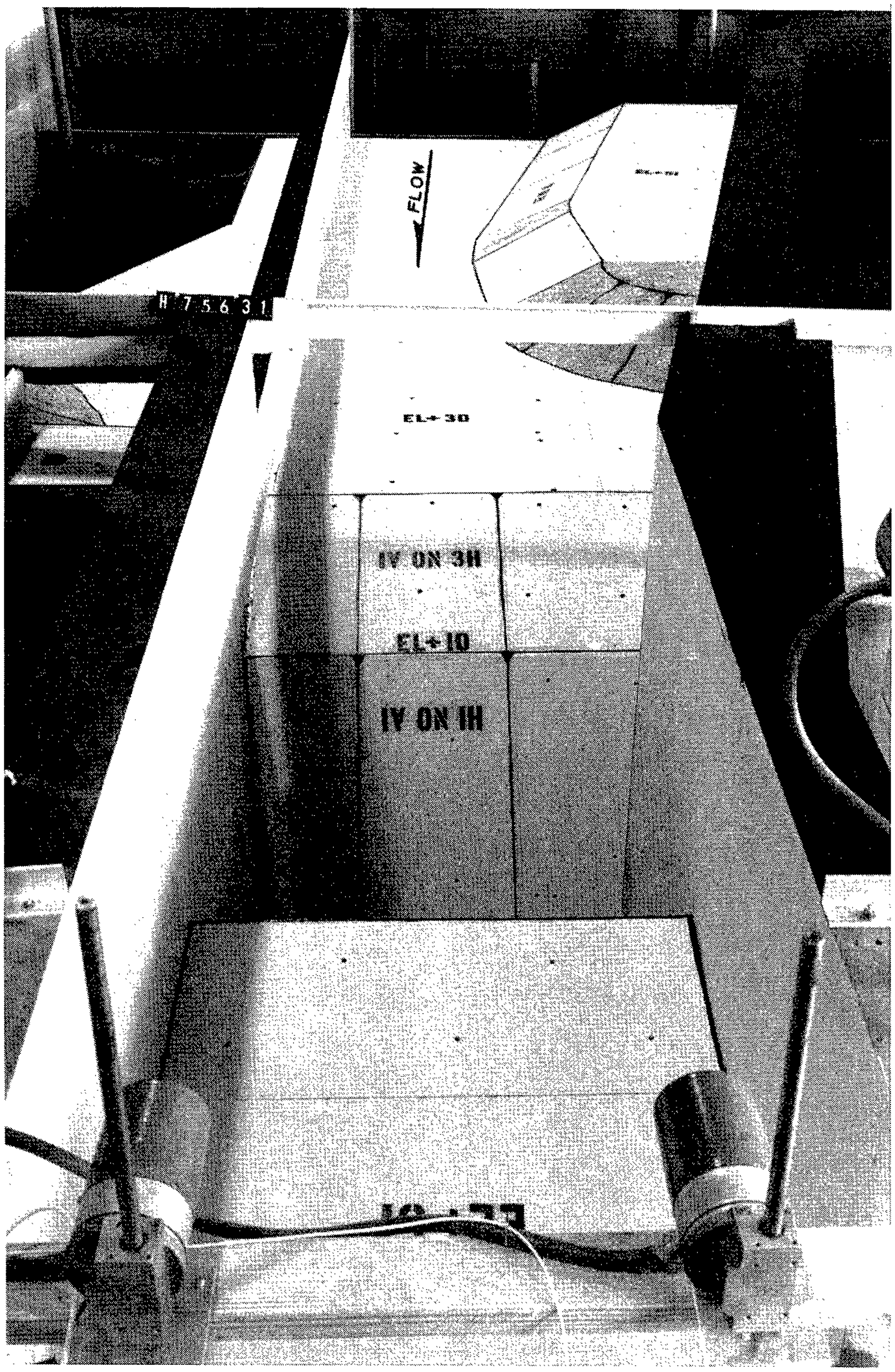


Figure 11. Upstream lock approach, type 2 design H-H pattern system, looking upstream

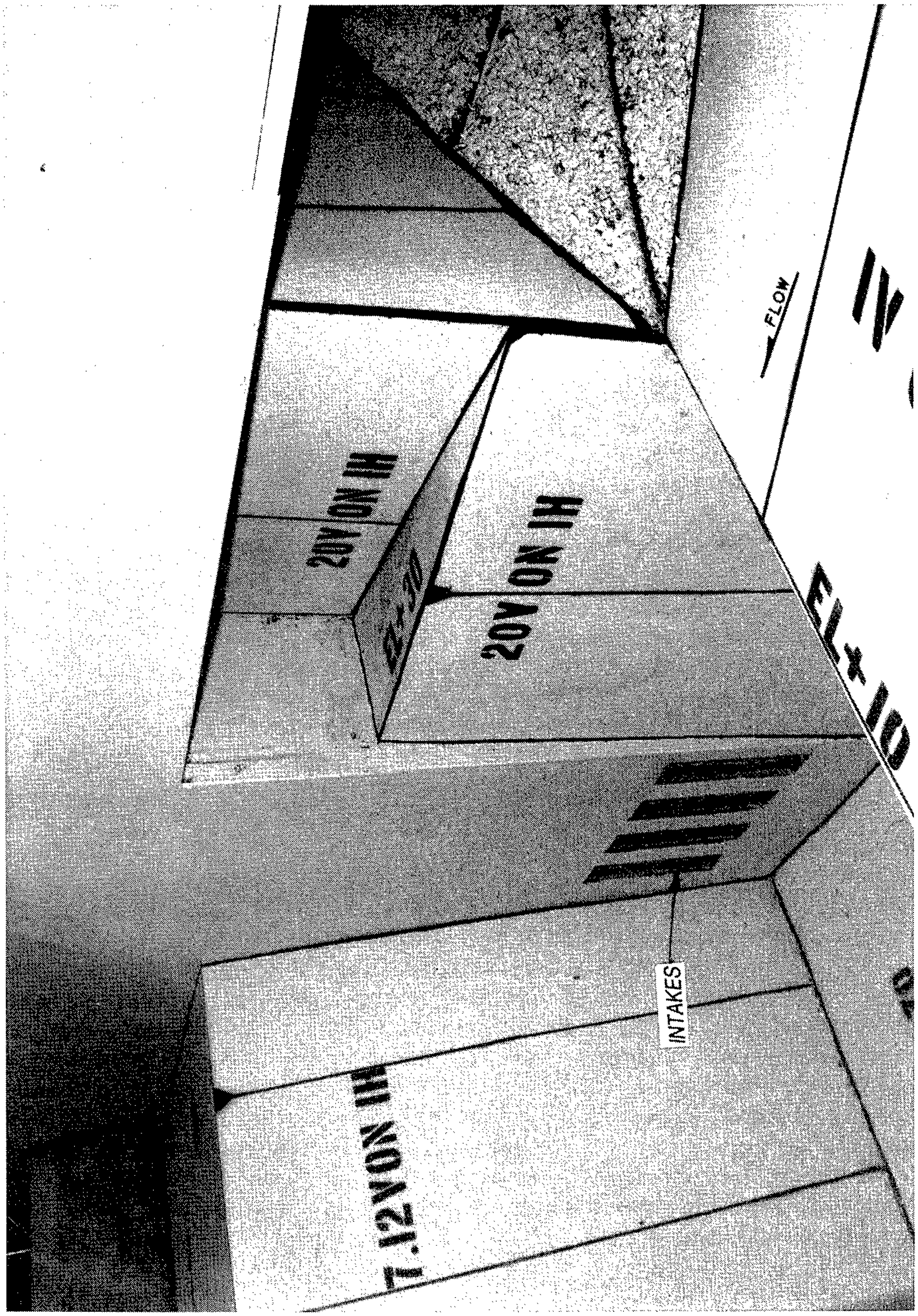
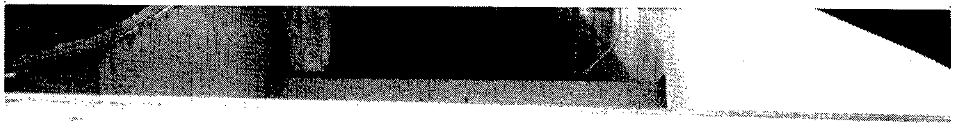


Figure 12. Topography in vicinity of the type 2 design intakes, H-H pattern system, looking upstream



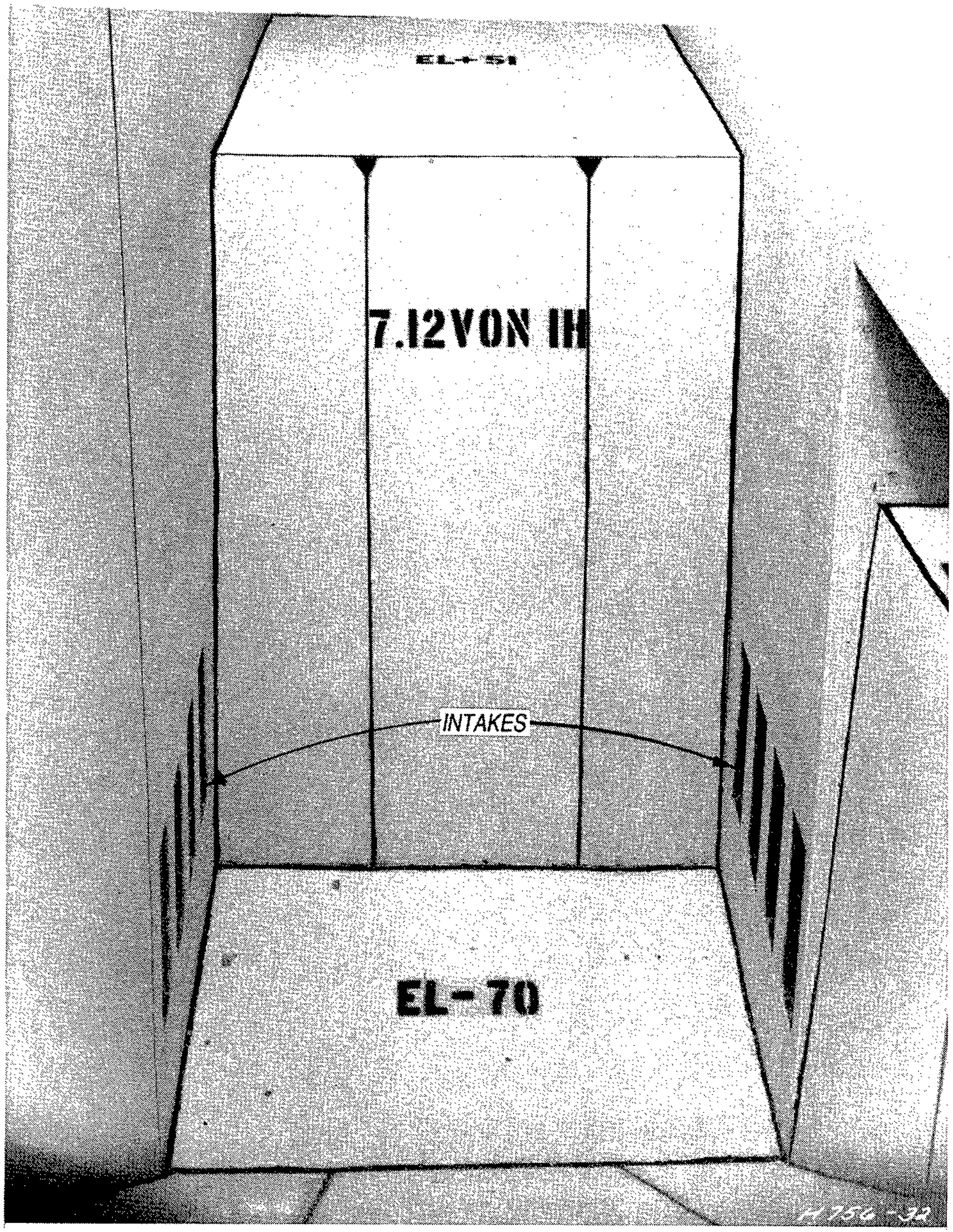


Figure 13. Type 2 design intakes, H-H pattern system, looking downstream

Under steady flow conditions, the flow distribution was basically even between ports, as shown in Plate 5.

Flow conditions in the upper approach to the lock and intake were studied during filling operations to ensure that conditions in this area would permit safe entrance and exit of tows and small craft. The limited amount of approach that was reproduced in the lock model confined the area of study to the immediate vicinity of the lock. Flow conditions during filling operations, shown in Photo 1, indicated a circulation pattern developed; however, no vortices developed.

Crossover and splitter manifolds

In the original design crossover culvert (Plate 2), the 2-ft-thick horizontal splitter wall ensured that the rate of flow to both the upstream and downstream splitter manifolds was about equal for both normal and single valve operation. Good flow distribution at the crossover resulted in equal division of flow to the splitter manifolds leading to the floor culverts. The area of the culvert decreased from 264 sq ft in the filling culvert to 240 sq ft in the longitudinal floor culverts (ratio of 1:0.91). The original design crossover and splitter manifolds were adopted as elements of the recommended design filling and emptying system.

Floor culvert manifolds and lock chamber details

The original design filling and emptying system (Figure 2, Plate 2) included four longitudinal floor culverts both upstream and downstream from the splitter manifolds. The floor of the 5-ft-wide by 12-ft-high floor culverts was set at el -28.0. The exterior roof was set at el -14.0, 21 ft below the lower pool elevation of 7.0. Each floor culvert consisted of six pairs of ports, each 1.25 ft wide by 3.46 ft high, spaced 14 ft on centers. Each floor culvert had a port-to-culvert-area ratio of 0.86.

Baffling adjacent to the longitudinal floor culvert was included in the system as an integral part of the design since energy dissipation and control of subsurface currents resulted in reduced hawser forces on moored tows and limited movement of free tows in the chamber. An overhanging ledge was provided above each individual port of the floor culvert.

Average pressures were measured throughout the entire filling and emptying system with a 69.5-ft lift, normal and single valve operations, and valve opening schedules of 1, 2, and 4 min. These data did not indicate any adverse or negative pressures in the type 2 design filling and emptying system. Piezometer locations are shown in Plate 3. Pressures resulting from 1-min normal valve filling and emptying operations are provided in Tables 1 and 2. Additional readings are given in Tables A1-A10. In these tables, elevations are in feet referenced to NGVD, T is time in prototype seconds

starting at the beginning of the filling or emptying operation, *UP* is the water-surface elevation in the upper pool, *LC* is the water-surface elevation in the lock chamber, and *LP* is the water-surface elevation in the lower pool.

Longitudinal and transverse hawser forces were measured on six-barge and four-barge tow arrangements located at various positions (Plate 6). These tests were conducted with normal and single valve operations, a 69.5-ft lift, and valve opening schedules of 1, 2, and 4 min. Maximum hawser forces ranging from 1 to 4 tons were measured during filling and emptying operations (Plates 7 and 8). Plots of filling and emptying times versus valve time for normal and single valve operations are shown in Plates 9 and 10.

Tests were conducted to observe free tow movement in the lock chamber using six-barge and four-barge tow arrangements with a 1-min normal valve operation and a 69.5-ft lift. Test results consistently indicated downstream longitudinal movement of the tows during filling operations (Plate 11). In two cases involving the six-barge tow and the four-barge tow initially positioned in the downstream portion of the lock, the tows hit the downstream miter gate during filling operations.

Tests were conducted with a portion of the downstream vertical baffles removed in an attempt to reduce the free tow movement. Unsatisfactory test results were obtained with this modification.

A slope modification (Plate 12) was installed on the lower sill of the downstream miter gate in another attempt to reduce downstream longitudinal movement of the tow. This was designated the type 4 design filling and emptying system. Satisfactory results were observed in free tow tests conducted with six-barge and four-barge tow arrangements, as shown in Plate 13. Tests conducted with a two-barge tow arrangement (two barges connected end to end, 42 ft by 440 ft) indicated more movement of the tow in the lock chamber than with the six-barge and four-barge tow arrangements due to the lighter displacement. However, no problems were observed.

Longitudinal and transverse hawser forces were measured on six-barge and four-barge tow arrangements positioned at different locations (Plate 6) with the type 4 design filling and emptying system installed. These tests were conducted with various lifts and depths of submergence during filling and emptying operations with valve opening schedules of 1, 2, and 4 min. With the maximum condition of the upper pool at el 82.5 and lower pool at el 7.0, hawser forces were under 5.0 tons during filling operations, as shown in Plate 14. With design conditions for a normal upper pool at el 76.5 and lower pool elevations at 7.0 and 5.0, maximum hawser forces during filling operations were 4 tons and less with normal and single valve operations, as shown in Plates 15 and 16. However, during emptying operations maximum hawser forces ranged up to 5 tons for design conditions (Plate 17) and 6 tons for a normal upper pool of 76.5 and lower pool at 5.0 (Plate 18). Test results indicated this increase in hawser forces was due to a small amount of wave action created by the shape of the upstream tainter gate and sill configuration.

Tests were also conducted to measure longitudinal and transverse hawser forces and observe free tow movement in the lock chamber with various depths of submergence during filling and emptying operations. Maximum longitudinal hawser forces measured were less than 5 tons with upper pool elevations of 74.5 and 72.5, lower pool elevations of 5.0 and 3.0, respectively, and normal valve operations for both filling and emptying operations (Plates 19 and 20). However, there was an increase in the transverse hawser forces during filling operations indicating that reducing the submergence does increase the hydraulic forces acting on tows. Free tow movement was also increased with reduced submergence, especially with a four-barge tow arrangement at the downstream end of the lock chamber, as shown in Plate 21 (compare Plates 13 and 21). The upper pool elevation was lowered along with the lower pool elevation in order to maintain a 69.5-ft lift with the data presented in Plates 22 and 23. Similar test results were observed with an increase in transverse hawser forces due to reduced submergence.

Modifications were then made to the upper sill to reduce the wave action that was created as the water surface overtopped the sill at el 51 during filling operations and as the water surface dropped below the top of the sill during emptying operations. The modification that produced satisfactory results incorporated a v-notch design in the sill (Plate 24) and a curved miter gate configuration (Photo 2). This modification, designated the type 6 design filling and emptying system, provided a gradual change in the lock chamber area between el 16 and 51 during filling and emptying operations. Longitudinal and transverse hawser forces measured during normal and single valve operations during filling and emptying operations are shown in Plates 25 and 26.

Pressures on culvert roof downstream of filling and emptying valves

Flow entering or leaving the lock chamber was controlled by two reverse tainter valves. The culverts were 12 ft wide by 14 ft high at the valves. The roof of the filling valve was at el -39.0, but sloped upward to el -31.0 immediately downstream (Plate 2). The pressures were recorded with the pressure transducer set at el -39.0, which resulted in 46 ft of submergence below a lower pool of el 7.0. The emptying valves were identical to the filling valves with the exception that the emptying valve roof was at el -31.0. This provided 38 ft of submergence below lower pool. The locations of these pressure transducers are shown in Plate 3.

Pressure data were recorded during normal and single valve operations with a 69.5-ft lift (upper pool el 76.5, lower pool el 7.0). The lowest average pressures that occurred immediately downstream of the filling and emptying valves are shown in Plate 27. The maximum and minimum values of instantaneous pressures, measured at the same time the lowest average pressures occurred, are also plotted in Plate 27. Because the valves were set so low, the hydraulic grade line did not fall below the roof of the culverts. These pressures are plotted versus filling and emptying times for valve times of 1, 2,

and 4 min. The values located by each data point are pressures in feet of water referenced to the roof of the culvert. Pressures in the prototype can be expected to be 4 to 5 ft less than those in the model due to increased velocities resulting from the difference in friction between the model and prototype.

Outlet manifold and downstream approach

The type 1 design discharge outlets (Photo 3, Plate 28), were installed in the downstream approach channel. The discharge laterals were interlaced such that the left culvert lateral was located upstream of the discharge lateral for the right culvert. The floor elevation of the discharge laterals was at el -34.0, 17 ft below the invert of the downstream approach channel. Each lateral had 8 pairs of equal-size ports, 2.25 ft wide by 4.46 ft high. The culvert at the entrance of each lateral was 12 ft wide by 14 ft high. This resulted in a port-to-culvert area ratio of 0.95. During design it was felt that a ratio of less than 1.0 was needed to maintain adequate positive pressure downstream of the empty valves during an emptying operation. Energy was dissipated by the impact of the jets of water against a vertical wall positioned 10 ft from the face of the ports. The laterals were separated by a 4-ft-thick vertical wall with a 2-ft overhang.

Flow conditions were observed at the discharge outlets and in the downstream approach channel. Satisfactory flow conditions were observed with normal and single valve operations and lower pool elevations ranging from 5.0 to 35.0. Flow conditions with a lower pool elevation of 5.0 are shown in Photos 4 and 5. Velocities measured at the discharge outlet ports varied considerably between upstream and downstream laterals (Plates 29-31) under steady-state conditions, but the distribution was considered satisfactory.

Recommended filling and emptying system (type 6)

Pertinent features of the filling and emptying system recommended for the H-H system are shown in Plate 32. Modifications to the original design filling and emptying system involved lowering the intakes (type 2 design), installing a slope modification on the lower sill (type 4 design), and incorporating a v-notch design in the upper sill and a curved miter gate (type 6 design). The type 6 design filling and emptying system included the original design intakes, crossover culverts, splitter manifolds, longitudinal floor culverts, discharge laterals, and upstream and downstream approach channel configurations.

Flow conditions in the lock chamber during filling operations for design conditions (69.5-ft lift) were satisfactory with only a small degree of surface turbulence observed (Photo 6). With a 1-min valve time and a 69.5-ft lift, the lock filled in 8.7 min. and emptied in 12.1 min. Hawser forces measured on six- and four-barge tow arrangements with a 14-ft draft were under 5 tons for all conditions tested with the v-notch design incorporated in the high sill. Free tow movement was reduced considerably with the slope modification in

the low sill. Unmoored tows either rose vertically or slowly drifted toward the center of the lock chamber.

Average pressures measured throughout the entire filling and emptying system for the 69.5-ft lift, normal and single valve operations, and valve opening schedules of 1, 2, and 4 min are provided in Tables 1 and 2. Piezometer locations are shown in Plate 3.

Overall lock coefficients, C_L, based on the normal filling and emptying data presented in Plates 9 and 10, were computed by the equation:

$$C_L = \frac{2A_L \left(\sqrt{H + d} - \sqrt{d}\right)}{A_c \, (T - Kt_v) \, \sqrt{2g}} \tag{1}$$

where

A_L = area of lock chamber, sq ft

H = initial head, ft

d = measured overfill or overempty, ft

A_c = area of culverts at valves, sq ft

T = filling or emptying time, sec

K = a constant

t_v = valve time, sec

g = acceleration due to gravity, ft/sec

The term $T - Kt_v$ is the lock filling or emptying time for the hypothetical case of instantaneous valve opening and can be obtained by extrapolation of the data presented in Plates 9 and 10. Computed coefficients for the type 6 system are 0.71 for filling and 0.49 for emptying.

H Pattern System

Original design filling and emptying system

The original design filling and emptying system (Plate 33) was very similar to both the Bay Springs and Walter Bouldin Lock filling and emptying systems that were developed in previous hydraulic model investigations (Ables 1978; George 1984). The use of intakes similar to the design used for the

H-H pattern system, modifications to the horizontal splitter wall near the crossover culvert, the Y portion of the tuning fork, and discharge outlets were the principal design changes. The primary elements of the Bonneville H pattern system consist of four-port intake manifolds leading to 12- by 14-ft culverts, which transition to 15-ft-diameter conduits aligned parallel to the lock walls; filling and emptying valves of the same size as the culverts; a crossover culvert with a horizontal splitter wall in each main culvert to divide flows into each half of the lock chamber in conjunction with two tuning forks leading to the four longitudinal floor culvert manifolds; and two discharge laterals interlaced to spread flow in the exit channel.

Upstream approach and intakes

The type 1 (original) design upstream approach and intake manifolds are shown in Plates 34 and 35. The roof of the intake manifolds, set at el -1.0, provided 71.0 ft and 77.5 ft of submergence for minimum and maximum pool elevations of 70 and 76.5, respectively. Flow conditions in the upper approach to the lock and intake were studied during filling operations. The limited width of approach reproduced in the 1:25-scale model of the lock filling and emptying system confined the area of study to the immediate vicinity of the lock intakes.

During filling operations, the type 1 (original) design upstream approach resulted in the formation of vortices in the vicinity of the intake ports. In the original design the intakes were located immediately downstream of an area where the bed slope was 1V on 1H. This bed slope resulted in rapid changes in the cross-sectional flow area. Observations of flow patterns indicated that lateral flow from under the floating guide wall contributed to the formation of the vortices. Surface currents of the type 1 design approach during a filling operation are shown in Photo 7. Steady-flow data showing velocities and flow distribution in the intake ports resulting with the type 1 design are shown in Plate 36. Tests results indicated that a significantly higher percentage of flow entered the intakes on the right wall (looking downstream) as compared with the intakes on the left wall due to the unsymmetrical approach conditions to the intakes.

The reason satisfactory flow conditions (no vortices) were observed with the intakes for the H-H pattern system was because there was 22 ft more submergence over the intakes for the H-H pattern system than for the H pattern system. Also, the floating guide wall design did not produce any adverse flow conditions in the vicinity of the intakes.

Various modifications were made to the upstream approach channel in an attempt to eliminate the formation of vortices during filling operations. Some modifications included structural and/or geotechnical as well as hydraulic concerns.

Representatives of the Portland District stated concerns that adverse flow conditions may be present in the vicinity of the lock intakes during filling when the Bonneville First Powerhouse is in operation. This concern was based upon observations made on the 1:100-scale general Bonneville model operated by the U.S. Army Engineer Waterways Experiment Station (WES). Because of the limited width of the approach reproduced in the 1:25-scale section model, flow from the first powerhouse could not be accurately simulated. Therefore, the 1:100-scale general model was used to observe flow conditions in the lock approach during filling operations with the first powerhouse operating. Tests were conducted using the general model to observe flow conditions with and without flow through the powerhouse with numerous modifications to the upstream approach channel.

It was determined from the 1:100-scale general model that the type 36 design approach was the optimum approach channel design for all flow conditions observed. The type 36 design approach (Figure 14 and Plate 37) consisted of a v-shaped channel having a gradual increase in cross-sectional flow area. The type 36 design approach channel was reproduced in the 1:25-scale section model (Figure 14 and Plate 37). Surface currents of the filling operation are shown in Photo 8. No vortices or concentrated swirls formed within the intake vicinity during filling operations. With the type 36 design upstream approach, steady flow conditions resulted in a satisfactory distribution of flow entering the right and left intakes as shown in Plate 38. Therefore, it was recommended that the type 1 (original) design intake manifold and the type 36 design upstream approach be retained in the recommended design filling and emptying system.

Crossover culvert and tuning fork sections

In the original design crossover culvert (Plate 33), one edge of the 2-ft-thick horizontal splitter wall was located 5 ft from the inside of the lock wall toward the center line of the lock and ended 30.5 ft upstream and downstream from station 26+09.17 (center line of crossover). The horizontal splitter wall differed from those tested for Bay Springs and Walter Bouldin in that the splitter in the latter projects initiated in the longitudinal culverts outside the limits of the lock chamber.

Considerable effort was placed in the design of the tuning fork section to ensure a constant and gradual expansion of the total cross-sectional area throughout the length of the tuning fork. Good flow distribution at the crossover resulted in equal division of flow at the vertical divider wall of the tuning fork leading to the four culverts for normal valve operations. Flow distribution was not ideally balanced within the tuning fork for single valve operations because of the large difference in cross-sectional area, which increased from 168 sq ft at the outside longitudinal culvert (flow in one culvert only) to 348 sq ft at the longitudinal floor culverts (ratio of 1:2.07). This imbalance of flow affected transverse hawser forces during single valve filling and is discussed further in the sections on floor culvert manifolds in this chapter. The

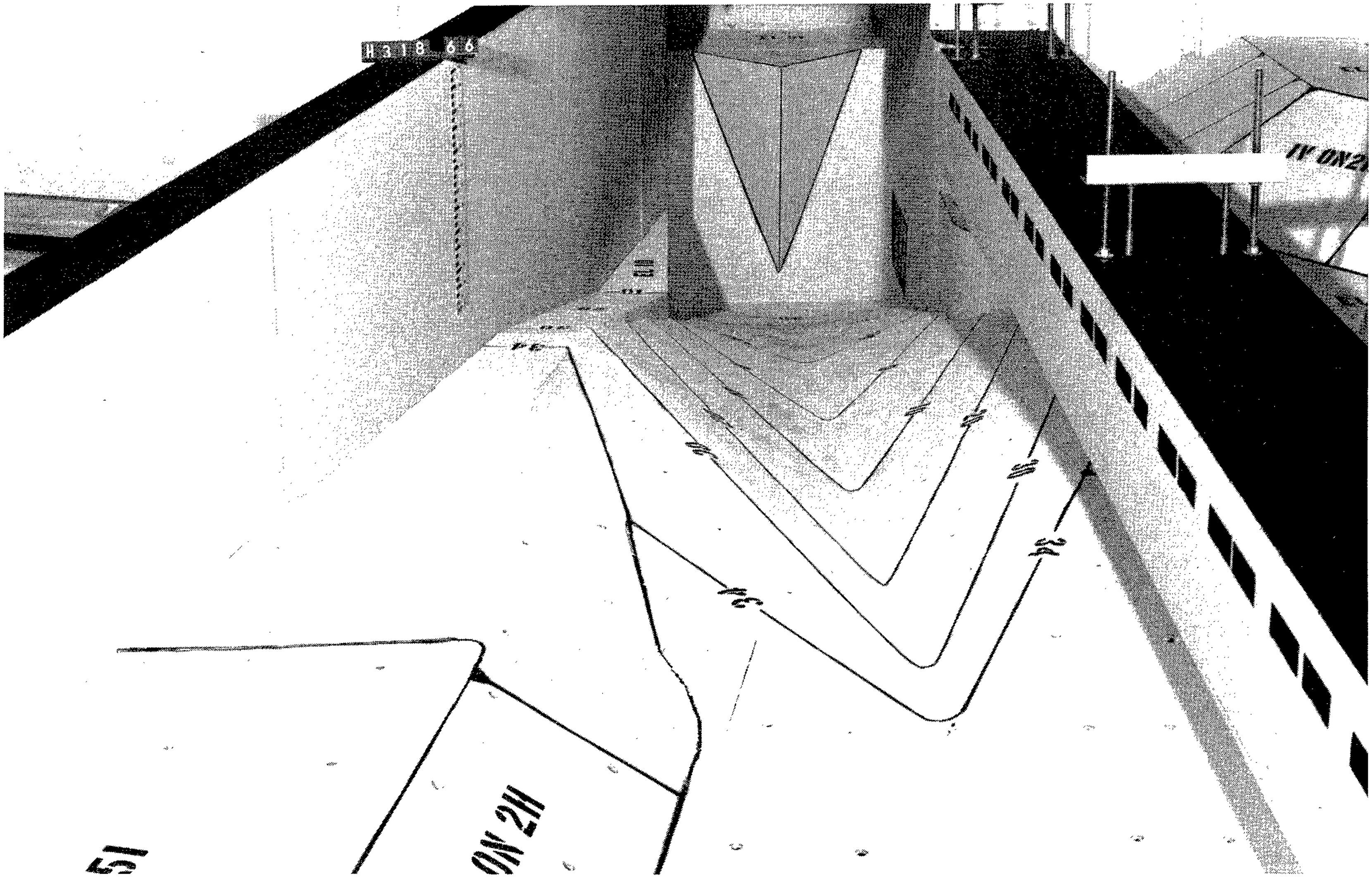


Figure 14. H pattern system upstream lock approach, type 36 design

original design crossover and tuning forks were adopted as elements of the recommended design filling and emptying system.

Floor culvert manifolds and lock chamber details (original design)

The original design filling and emptying system included two longitudinal floor culverts both upstream and downstream from the tuning forks (Plate 33). The floor of the 12-ft-wide by 7.25-ft-high floor culverts was set at el -24.25. The exterior roof was set at el -14.0, 21 ft below the lower pool elevation of 7.0. Each floor culvert consisted of 10 pairs of ports, each 1.25 ft wide by 3.46 ft high, spaced 20 ft on centers and positioned symmetrically about the quarter points of the chamber length. Each floor culvert had a port-to-culvert-area ratio of 0.99.

Baffles were located along the lock walls and along the center line of the lock (Plate 39). The baffles are a critical element of the design of high-head locks using bottom longitudinal floor culverts. They facilitate the distribution and dissipation of energy contained in the flow jets issuing from the manifold ports. The original baffling is shown in Plate 33. An overhanging ledge was provided above each individual port of the floor culvert.

The upstream high sill was notched to reduce the wave created (and thus hawser forces) as the water surface overtopped the sill at el 51.0. The notch provided a gradual change in lock chamber area between el 16.0 and 51.0 during filling and emptying.

With a 1-min valve time and a 69.5-ft lift, the lock filled in 10.3 min, and surface turbulence in the chamber was satisfactory (Photo 9). Tests were conducted to observe free tow movement in the lock chamber using six- and four-barge tow arrangements with 1-min normal valve operations and a 69.5-ft lift. These tests provide a good indication of how uniform the flow distribution is in the lock chamber during a fill operation. Tests results with the type 1 (original) design filling and emptying system indicated that during filling, the six-barge tow arrangement (tow position 1, Plate 40) and a four-barge tow arrangement, when initially positioned near the miter gate (tow position 4), hit the downstream miter gate early into the fill operation. The results of free tow tests for the different tow positions with the type 1 design are presented in Plate 41.

At a 69.5-ft lift the lock emptied in about 13.8 min with a 1-min valve time. Plates 42 and 43 are plots of filling and emptying time versus valve time for normal and single valve operations, respectively.

Floor culvert manifolds and lock chamber details (alternate designs)

Tests were conducted with various modifications to particular elements in the lock chamber involving different baffling arrangements and lower sill

slopes as shown in the following chart. During these tests, observations were made of turbulence in the lock chamber and the movement of free tows, and in some tests, longitudinal and transverse hawser forces were measured. These tests revealed that adjustments were needed to the vertical baffle supports to optimize energy dissipation.

In order to obtain both longitudinal and transversely balanced hawser forces on various sized tows moored at several positions in the lock chamber with normal and single valve operations, it was necessary to place the vertical support walls at different locations on each end of the lock. This was the only part of the system that was not symmetrical.

Floor culvert manifolds and lock chamber details (recommended design)

The floor culvert manifold recommended consisted of 10 pairs of ports, 3.46 ft high by 1.25 ft wide. The ports were spaced 20 ft on centers, and the port groups were centered on the quarter points of the lock chamber. The vertical baffles (located on the center line of lock and on the lock walls) were centered between the ports in the floor culverts, the most upstream set of vertical baffles and the last two sets of vertical baffles at the downstream end were eliminated, and 1V on 2H slopes were installed in the low sills at each end of the lock chamber. Details of the recommended baffling and sill slopes are shown in Plate 44.

Outlet manifold and downstream approach

The type 1 (original) design outlets shown in Plate 45 were installed in the downstream approach canal. The discharge laterals were interlaced such that the right culvert lateral was located upstream of the discharge lateral for the left culvert. The floor elevation of the discharge laterals was at el -34.0, 17 ft below the invert of the downstream approach canal. Each lateral had eight pairs of equal-size ports, 2.25 ft wide by 4.46 ft high. The culvert at the entrance of each lateral was 12 ft wide by 14 ft high. This resulted in a port-to-culvert area ratio of 0.95. During design it was felt that a ratio of less than 1.0 was needed to maintain adequate positive pressure downstream of the empty valves during emptying. Energy was dissipated by the impact of the jets of water against a vertical wall positioned 10 ft from the face of the ports. The laterals were separated by a 4-ft-thick vertical wall with a 2-ft wide overhang. Although the placement of the laterals differed from that of the H-H pattern system, the manifolds were similar enough that the flow distribution would not differ. Distribution of flow measured under steady-flow conditions with the H-H pattern, shown in Plates 29-31, were considered satisfactory. Flow conditions observed with normal and single valve operations produced only mild turbulence at the maximum discharges, as shown in Photo 10. A water-surface profile along the center line between approach walls indicated only slight increases in the water-surface elevation

Filling and Emptying Systems Type	Manifold Baffling		Lower Sill Slope		Crossover Topography	
	Type	Description	Type	Description	Type	Description
1	1	See Plate 32	1	See Plate 32	1	See Plate 32
2	1		2	1V on 2H at each lower sill	1	
3	1		3	1V on 1H at each lower sill	1	
4	2	Type 1 baffles with last vertical baffle at downstream end removed	3		1	
5	1		1		2	See Plate 68
6	1		2		2	
7	1		3		2	
8	1		4	Vertical face at upstream lower sill, 1V on 1H at downstream lower sill	2	
9	2		3		2	
10	3	Vertical baffles located symmetrically about manifold ports (20′ C-C)	3		1	
11	4	Type 3 baffles with last vertical baffle at downstream end removed	3		1	
12	5	Type 3 baffles with first vertical baffle at upstream end and last vertical baffle at downstream end removed	3		1	
13	6	See Plate 44	3		1	
14	6		2		1	

(Continued)

(Concluded)

Filling and Emptying Systems Type	Manifold Baffling		Lower Sill Slope		Crossover Topography	
	Type	Description	Type	Description	Type	Description
15	7	Type 6 baffles with overhang above the ports throughout the length of each floor culvert	2		1	
16	8	Type 6 baffles with first vertical baffle from the crossover removed	2		1	
17	9	Type 8 baffle with slope between legs of tuning fork	2		1	
18	10	Type 9 baffles with first two vertical baffles from the crossover removed	2		1	
19	6	See Plate 68	2	See Plate 68	2	See Plate 68

Note: Each filling and emptying system design used the type 1 intakes, filling and emptying valves, crossover culvert, floor culvert manifolds, and outlets.

over the discharge lateral at peak discharges as shown in Plate 46. The type 1 (original) design discharge laterals were adopted in the recommended design filling and emptying system.

Pressures on culvert roof downstream of filling and emptying valves

Flow entering or leaving the lock chamber was controlled by two reverse tainter valves. The culverts were 14 ft high by 12 ft wide at the valves. The roof of the filling valve at el -17.0 resulted in 24 ft of submergence below a lower pool of el 7.0. The emptying valves were identical to the filling valves with the exception that the emptying valve roof was at el -18.0. This provided 25 ft of submergence below lower pool. The original design positions are shown in Plate 33.

Pressure data were recorded during filling and emptying operations with 69.5-, 71.5-, and 75.5-ft lifts with tailwaters of el 7.0 and el 5.0. Pressures were measured at station 22+41.6 during filling and at station 29+10.7 during emptying. Time-history plots of minimum pressures downstream of the filling and emptying valves for normal and single valve operations are presented in Plates 47-50. Minimum pressures are also plotted versus filling and emptying times for valve times of 1, 2, and 4 min and various initial heads in Plates 51 and 52. No severe negative pressures were observed during filling or emptying.

Because of inertial effects a 1-min valve schedule for both filling and emptying resulted in the largest minimum pressures at the valves. Therefore, it is recommended that the lock valves be operated at 1-min valve schedules for the design lift conditions.

Pressures throughout the filling and emptying system

Average pressures were measured throughout the entire filling and emptying system with a 69.5-ft lift, normal and single (right only) valve operations, and valve schedules of 1, 2, and 4 min. Piezometer locations are shown in Plate 53, and tables of the pressures recorded are presented in Tables 3, 4, and A11-A20.

Steady-flow tests were conducted to quantify hydraulic coefficients particular to this lock filling and emptying system. The discharges and associated pressures for steady flow simulating normal and single valve filling and emptying operations are presented in Tables 5-10. Pool elevations were arbitrarily set since the test results would be presented in dimensionless form.

The head losses in the system can be quantified by the use of loss coefficients:

$$K_i = \frac{H_{L_i}}{V_c^2/2g} \tag{2}$$

where

K_i = component loss coefficient

H_{L_i} = head loss through component i, ft

V_c = average culvert velocity at the valve, fps

The filling system was divided into the following components:

Component	Reference Piezometers
Intake manifold	Upper pool elevation and piezometer 14
Filling valve	Piezometer 14 (14A) and piezometer 15 (15A)
Filling culvert	Piezometer 15 (15A) and piezometer 27 (27A)
Outlet culverts	Piezometer 27 (27A) and lock chamber water-surface elevation

It is noted that the outlet culverts consist of the crossover, Y, and floor manifolds.

Loss coefficients for normal valve filling are listed in the following tabulation:

Component	K_i Average
Intake manifold	0.24
Filling valve	0.35
Filling culvert	0.31
Outlet culverts	1.81

The value of K_{T_F}, the overall loss coefficient for the filling system, is 2.71. The lock coefficient is related to the lock loss coefficient as:

$$C_L = \frac{1}{\sqrt{K_T}} \; or \; (K_T)^{-1/2} \tag{3}$$

The lock coefficient of the filling system is 0.61.

Head losses in the emptying system can be subdivided as follows:

Component	Reference Piezometers
Intake culverts	Lock chamber water-surface elevation and piezometer 27 (27A)
Emptying culvert	Piezometer 27 (27A) and piezometer 137 (137A)
Emptying valve	Piezometer 137 (137A) and piezometer 138 (138A)
Outlet culverts	Piezometer 138 (138A) and lower pool elevation

It is noted that the intake culverts consist of the floor manifolds, Y, and crossover. The outlet culverts consist of the culverts downstream of the valve and the outlet manifold.

Loss coefficients for normal valve emptying are listed in the following tabulation:

Component	K_l Average
Intake culverts	1.75
Emptying culvert	0.87
Emptying valve	0.03
Outlet culverts	1.89
K_{T_E} =	4.54

The overall lock coefficient for the emptying system is 0.47.

Review of the pressure data revealed that with the exception of the pressures in the crossover bends no adverse pressures were recorded during filling or emptying. However, there was concern regarding pressures in the crossover bends. Plots of piezometric elevation (referenced to the maximum roof elevation, el -17.0) within the crossover bends versus time during filling and emptying for various valve operations are presented in Plates 54 and 55. The lowest pressure measured was 6 ft below the roof elevation of the culvert. This pressure was recorded during a 1-min single-valve filling operation.

Single-stepped-valve operation

As mentioned in the preceding paragraph, the lowest average pressure measured in the crossover section of the filling and emptying system was 6 ft below the roof elevation of the culvert during a 1-min single-valve filling operation for the design lift of 69.5 ft. Because of frictional differences between the model and prototype, average pressures in the prototype crossover may be as low as 16 ft below the culvert roof elevation. Even though these low pressures occur for only a limited time during filling due to the decreasing head, there was concern that these pressures were excessively low.

Engineers from the Portland District and WES agreed that the average pressures measured in the model crossover should be approximately 10 ft above the culvert roof elevation in order to avoid potential problems in this area. A stepped-valve operation was proposed for single-valve filling for the design lift of 69.5 ft in an attempt to raise the pressures in the crossover. The stepped-valve schedules tested were based upon a theoretical analysis of the pressures throughout the system. This analysis was conducted by WES personnel.

Stepped-valve schedule 1 consisted of opening the valve 2.8 ft in 0.3 min, holding the valve at this position for 7.5 min, then opening the valve to full open resulting in a total valve time of 8.5 min (Plate 56). The lock filled in about 25.6 min (one valve operation) using this stepped-valve operation and a 69.5-ft lift.

Average pressures were measured throughout the filling system with a 69.5-ft lift for single valve operations. Piezometer locations are shown in Plate 53. Pressures recorded during single-valve filling operations using stepped-valve schedule 1 are presented in Table A21. Plots of piezometric elevation (referenced to the maximum roof elevation, el -17.0) within the crossover bends versus time during filling are presented in Plate 57. The lowest pressure measured in the crossover culvert was 10 ft above the elevation of the culvert roof.

Representatives of the Portland District requested that tests be conducted with stepped-valve schedule 2, which consisted of opening the valve to 2.0 ft in 0.22 min, holding the valve at this position for 7.5 min, then opening the valve to full open resulting in a total valve time of 8.5 min (Plate 56). The stepped-valve schedule 2 resulted in a single-valve filling time of about 25.7 min for a 69.5-ft lift. Average pressures measured during single-valve filling with this schedule are presented in Table A22. Plots of pressures recorded in the crossover bends are provided in Plate 58. The lowest pressure measured using the stepped-valve schedule 2 was 8 ft above the culvert roof elevation.

Test results utilizing stepped-valve operations indicated that pressures could be raised to an acceptable level in the filling and emptying system; therefore, additional tests with other stepped-valve operations were not conducted.

Recommended filling and emptying system (type 14)

Features of the filling and emptying system recommended for the new Bonneville Lock are shown in Plate 53. The type 14 design included the original intakes, crossover culvert, tuning fork, filling and emptying valve locations, floor culvert manifold, discharge lateral, and downstream approach; the type 36 design upstream approach (Plate 37); and the lock chamber baffling arrangement and sill slopes shown in Plate 53.

Flow conditions in the lock chamber during filling operations were very good with only a small amount of surface turbulence. Photo 11 shows conditions in the lock chamber during filling. The type 14 design resulted in some drift of the four-barge tow arrangements toward the center of the lock chamber and very little or no horizontal movement of the six-barge tow arrangement during filling operations. The results of free tow tests with the type 14 design are shown in Plate 59. For the design lift of 69.5 ft, hawser forces were 5 tons or less with the type 14 design as shown in Plates 60 and 61. Data obtained during typical 1-min normal and 1-min single-valve filling operations are plotted in Plates 62 and 63, respectively.

Tests conducted on the type 14 design with two lifts greater than the design lift of 69.5 ft found that the design performed adequately at these conditions. A lift of 71.5 ft with an upper pool elevation of 76.5 and a lower pool elevation of 5.0 (2 ft below design tailwater) resulted in maximum transverse hawser forces between 5 and 6 tons for 1-min single valve operations (Plate 64). The maximum hawser forces for all other valve operations for these upper and lower pool elevations were less than 5 tons, as shown in Plates 64 and 65. Hawser forces for a 75.5-ft lift with an upper pool elevation of 82.5 and a lower pool elevation of 7.0 were 5 tons or less (Plates 66 and 67). Hawser forces were more dependent upon the submergence in the lock chamber (distance from lower pool elevation to lock chamber floor) than on the initial head.

Characteristics to be expected with the type 14 design system during filling and emptying are dependent on the valve time selected. A 1-min valve time is recommended for filling and emptying with normal valve operations and the design lift of 69.5 ft. The filling time in the model was 10.3 min. A stepped-valve schedule such as the ones shown in Plate 56 is recommended for single valve filling with the design lift of 69.5 ft. Stepped-valve schedule 2 (Plate 56) resulted in a single-valve filling time of approximately 25.7 min. Model emptying times for a 1-min valve schedule were 13.8 min for normal and 26.1 min for single valve operations. Friction losses in a 1:25-scale model are larger than prototype friction losses. Prototype tests of the Bankhead Lock (Tool 1980) and Bay Springs Lock (McGee 1989) with systems similar to the new Bonneville Lock revealed that the model can be

expected to fill and empty approximately 15 percent faster than the model (8.8 min and 11.7 min, respectively).

Overall lock coefficients, C_L, based on steady-flow tests for the type 14 design filling and emptying system are 0.61 for filling and 0.47 for emptying.

Lock chamber topography near crossover culvert

The Portland District requested that tests be conducted to determine if excavation of the entire crossover area in the lock chamber was necessary in order to ensure acceptable drift patterns and hawser forces. Modifications involving topography around the crossover were installed, and this was designated the type 19 design filling and emptying system (Plate 68). The type 19 design differed from the type 14 design only in the topography in the vicinity of the crossover.

Tests were conducted with the type 19 design to observe free tow movement in the lock chamber for a 69.5-ft lift and to measure longitudinal and transverse hawser forces for 69.5-, 71.5-, and 75.5-ft lifts. Test results indicated that there were no significant differences in drift patterns (Plate 69) or hawser forces (Plates 70-75) between the type 14 and type 19 design filling and emptying systems.

Tests conducted for 58-ft lift

Tests were conducted to document the filling and emptying system for a 58-ft lift (upper pool el 74.0, lower pool el 16.0). Plots of valve time versus filling and emptying times for normal and single valve operations are shown in Plates 42 and 43. Average pressures were measured throughout the entire filling and emptying system with normal and single valve operations, and valve speeds of 1, 2, and 4 min. The pressures recorded for a 58-ft lift are presented in Tables A23-A34.

Longitudinal and transverse hawser forces during filling and emptying were also measured for a 58-ft lift. As expected, hawser forces for a 58-ft lift were significantly less than the forces measured for the design lift of 69.5 ft. Plots of hawser forces versus valve time for the various tow positions (Plate 40) are shown in Plates 76 and 77.

4 Discussions and Recommendations

A model study was conducted to ensure that the proposed new Bonneville Lock system will provide a safe and efficient means for filling and emptying the lock. Studies were conducted with two different bottom longitudinal filling and emptying systems. The first system tested consisted of eight longitudinal floor culverts and for the purpose of this report was defined as the H-H pattern system. The second filling and emptying system tested included four longitudinal floor culverts and was defined as the H pattern system.

H-H Pattern System

Tests conducted with the H-H pattern system indicated that with modifications to the high and low sills, the symmetrical floor culvert system resulted in a system capable of fast filling and emptying with relatively calm water in the lock chamber and consequently low hawser forces.

Initially, the tops of the four-ported intake manifolds were located at el 20.0. However, due to foundation concerns the intake manifolds were moved early in this study closer to the high sill and lowered to el -23.0 (top of intake manifolds). This resulted in having 93.0 ft and 99.5 ft of submergence for minimum and maximum pool elevations of 70.0 and 76.5, respectively. Flow conditions were satisfactory with no vortices developing in the vicinity of the intakes during filling operations.

When the valves were opened in 1 min with the type 6 (recommended design) filling and emptying system, the model lock chamber filled 69.5 ft in 8.7 min and emptied in 12.1 min. Due to differences in friction losses, the prototype locks can be expected to fill and empty about 20 percent faster than the model lock or in 7.0 and 9.7 min, respectively.

Pressures measured on the roofs of the culverts immediately downstream of the filling and emptying valves indicated that the pressure at the roof of the culverts, with either single or normal valve operations, is always positive. For this reason air vents are not required for this system.

Flow conditions in the lock chamber during filling operations were satisfactory with only a small degree of surface turbulence observed. Hawser forces measured on six- and four-barge tow arrangements were under 5 tons for all conditions tested with the type 6 design. Free tow movement was reduced significantly with the sloped modification installed in the lower sill. Unmoored tows either rose vertically or slowly drifted toward the center of the lock chamber.

H Pattern System

Results of the model tests conducted on the H pattern system verified the effectiveness of the proposed filling and emptying system and were used to develop modifications to the upstream approach, baffling, and low sills.

Vortices formed with the type 1 (original) design upstream approach. Ambient currents in the intake vicinity prior to lock filling were noted in the 1:100-scale general Bonneville model operated by WES. These initial conditions to lock filling were not reproduced in the 1:25-scale filling and emptying model. Therefore, tests were conducted using the 1:100-scale model to determine the recommended upstream approach (type 36). The type 36 design approach (Figure 14 and Plate 37) consisted of a V-shaped channel having a gradual increase in cross-sectional flow area. Subsequent testing in the 1:25-scale model of the type 36 design upstream approach found the flow conditions to be satisfactory and vortex free. The four-port type 1 (original) design intake when used in conjunction with the type 36 design upstream approach performed adequately and resulted in a good port flow distribution. The type 36 design upstream approach and type 1 (original) design intake were adopted for the recommended system.

With the type 14 system and a 1-min valve, the lock chamber filled in 10.3 min and emptied in 13.8 min. Due to differences in friction losses, the prototype can be expected to fill and empty about 15 percent faster than the model (8.8 min and 11.7 min, respectively). During filling, surface turbulence in the lock chamber was excellent. Unmoored four-barge tows in the chamber rose vertically or drifted toward the center of the lock chamber, and the horizontal movement of a six-barge tow was virtually nonexistent. Unmoored tows should not be permitted in locks, but this performance provides a good indication of how uniform the flow distribution was in the lock chamber during a fill operation.

Baffling in the vicinity of the floor culvert manifolds is a critical element of a high-head longitudinal floor culvert system. Baffling was used to direct and distribute the flow issuing from the manifold ports. The type 14 design system included an unsymmetrical baffling arrangement and slopes placed on the lower sills and resulted in low hawser forces and minor movement of free tows during fast filling. Adjustments of the manifold baffling and sill slopes for the recommended design was one of the most important results of the model investigation.

References

Ables, J. H., Jr. (1978). "Filling and emptying system for Bay Springs Lock, Tennessee-Tombigbee Waterway, Mississippi; hydraulic model investigation," Technical Report H-78-19, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

George, John F. (1984). "Filling and emptying system, Walter Bouldin Lock, and lock culvert valve for Coosa River Waterway, Alabama; hydraulic model investigation," Technical Report HL-84-8, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

McGee, R. G. (1989). "Prototype evaluation of Bay Springs Lock, Tennessee-Tombigbee Waterway, Mississippi," Technical Report HL-89-15, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

Tool, A. R. (1980). "Prototype filling and emptying system measurements, New Bankhead Lock, Black Warrior River, Alabama," Technical Report HL-80-13, U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.

U.S. Army Engineer Division, North Pacific. (1979). "Navigation lock for Lower Granite Dam, Snake River, Washington; hydraulic model investigations," Technical Report No. 126-1, Performed for U.S. Army Engineer District, Walla Walla, Walla Walla, WA.

Table 1
H-H Pattern System, Average Piezometer Reading During Filling Operation, T
Lower Pool El 7, Normal Valve Operation

No.	Elev.	T=0	T=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150
UP	—	76.5	75.9	76.5	76.5	75.9	75.9	75.9	75.3	75.3	75.3
LC	—	7.0	7.6	7.6	9.3	12.1	16.1	19.5	23.0	26.9	33.8
LP	—	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	6.4	7.0
1	-53.0	76.5	76.5	75.4	74.8	73.7	73.1	72.0	72.6	72.6	73.1
2	-53.0	76.5	76.5	75.4	73.7	72.6	70.9	70.9	70.9	70.3	70.9
3	-53.0	76.5	75.9	75.4	74.2	72.0	70.8	70.3	70.8	70.8	72.0
4	-53.0	76.5	76.5	75.9	74.3	72.0	70.3	69.2	69.2	69.8	70.9
5	-53.0	76.5	75.4	74.8	72.6	70.9	68.6	68.1	68.1	68.1	68.6
6	-53.0	76.5	75.9	75.4	73.7	71.4	69.2	69.2	69.2	69.2	69.7
7	-53.0	76.5	76.5	75.4	74.2	72.5	71.9	70.8	70.8	71.3	72.5
8	-53.0	76.5	75.9	74.8	72.5	69.7	66.9	66.3	66.9	66.9	68.0
9	-53.0	76.5	75.9	74.7	72.4	69.4	67.0	67.0	67.0	67.6	68.2
10	-46.0	76.5	74.2	70.3	62.4	51.7	42.6	38.1	37.5	39.2	43.8
11	-42.5	76.5	73.7	69.2	60.1	46.0	37.6	35.9	37.0	39.3	44.3
12	-46.0	76.5	74.2	69.1	59.9	45.6	38.1	35.8	37.5	39.8	45.0
13	-49.5	76.5	75.4	70.3	61.8	50.5	44.8	42.6	44.3	46.0	49.9
14	-53.0	7.0	7.6	5.3	12.7	27.7	32.3	34.6	38.0	40.3	45.5
15	-46.0	7.0	8.1	5.9	10.4	26.8	31.9	34.1	37.5	39.8	45.4
16	-3.0	76.5	74.2	69.2	59.6	44.4	36.5	36.0	38.2	40.5	45.5
17	-3.0	7.0	7.0	5.3	8.7	26.4	33.2	36.1	38.3	40.6	45.7
18	-39.0	7.0	8.7	6.4	9.3	21.8	25.8	29.8	32.6	35.5	41.2
19	-38.4	7.0	8.1	6.4	8.7	24.8	30.0	33.4	37.4	39.2	43.8
20	-37.7	7.0	6.4	6.4	8.7	27.9	33.6	37.5	39.8	42.6	47.7
21	-37.4	7.0	7.6	4.7	7.0	27.7	34.6	38.0	40.9	43.2	48.4

Average Piezometer Reading During Filling Operation, Type 2 System, Lift 69.5 ft, Valve Speed 1 Min (Constant Speec
mal Valve Operation

15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150	T=180	T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=660
.9	76.5	76.5	75.9	75.9	75.9	75.3	75.3	75.3	74.8	75.3	75.3	75.3	76.5	75.9	75.9	75.9	75.9
.6	7.6	9.3	12.1	16.1	19.5	23.0	26.9	33.8	40.0	50.9	60.0	66.8	71.9	75.4	77.1	77.6	77.1
.0	7.0	7.0	7.0	7.0	7.0	7.0	6.4	7.0	7.0	7.0	7.0	7.0	6.4	6.4	7.0	7.0	7.0
.5	75.4	74.8	73.7	73.1	72.0	72.6	72.6	73.1	73.1	74.2	74.8	75.4	75.9	75.9	75.9	76.5	76.5
.5	75.4	73.7	72.6	70.9	70.9	70.9	70.3	70.9	71.5	72.6	73.7	74.3	74.8	75.4	75.4	75.4	75.9
.9	75.4	74.2	72.0	70.8	70.3	70.8	70.8	72.0	72.5	72.5	74.2	74.8	75.4	75.9	75.9	75.9	76.5
.5	75.9	74.3	72.0	70.3	69.2	69.2	69.8	70.9	71.4	72.0	73.7	74.8	75.9	75.9	76.5	76.5	77.1
.4	74.8	72.6	70.9	68.6	68.1	68.1	68.1	68.6	69.7	70.9	73.1	74.2	74.8	75.4	75.4	75.9	75.9
.9	75.4	73.7	71.4	69.2	69.2	69.2	69.2	69.7	70.9	72.0	73.7	74.2	75.4	75.9	75.9	75.9	75.9
.5	75.4	74.2	72.5	71.9	70.8	70.8	71.3	72.5	72.5	73.1	74.2	75.4	75.4	75.9	75.9	76.5	76.5
.9	74.8	72.5	69.7	66.9	66.3	66.9	66.9	68.0	69.1	70.8	74.8	74.2	75.4	75.9	76.5	75.9	76.5
.9	74.7	72.4	69.4	67.0	67.0	67.0	67.6	68.2	69.4	71.2	72.4	74.1	74.7	75.9	75.9	75.9	75.9
.2	70.3	62.4	51.7	42.6	38.1	37.5	39.2	43.8	48.3	56.7	63.5	68.6	72.5	74.8	75.9	76.5	75.9
.7	69.2	60.1	46.0	37.6	35.9	37.0	39.3	44.3	48.9	57.3	63.5	68.0	72.0	74.2	75.4	75.9	75.9
.2	69.1	59.9	45.6	38.1	35.8	37.5	39.8	45.0	49.0	57.0	63.9	69.1	71.9	74.8	75.9	75.9	75.9
.4	70.3	61.8	50.5	44.8	42.6	44.3	46.0	49.9	53.9	61.2	66.3	70.3	73.1	75.4	76.5	77.1	77.1
.6	5.3	12.7	27.7	32.3	34.6	38.0	40.3	45.5	49.5	57.5	64.4	69.6	72.5	75.4	75.9	76.5	76.5
.1	5.9	10.4	26.8	31.9	34.1	37.5	39.8	45.4	49.4	57.3	63.5	68.6	72.0	74.2	75.4	75.9	75.9
.2	69.2	59.6	44.4	36.5	36.0	38.2	40.5	45.5	49.5	57.9	64.1	68.6	72.0	74.2	75.4	75.9	75.9
.0	5.3	8.7	26.4	33.2	36.1	38.3	40.6	45.7	50.3	57.7	64.5	69.1	72.5	74.2	75.4	75.9	76.5
.7	6.4	9.3	21.8	25.8	29.8	32.6	35.5	41.2	46.3	55.4	62.3	68.5	72.5	75.4	76.5	77.1	76.5
.1	6.4	8.7	24.8	30.0	33.4	37.4	39.2	43.8	48.9	56.4	64.4	69.0	72.5	74.8	75.9	75.9	75.9
.4	6.4	8.7	27.9	33.6	37.5	39.8	42.6	47.7	51.1	57.9	64.1	68.6	72.5	74.2	75.9	75.9	75.9
.6	4.7	7.0	27.7	34.6	38.0	40.9	43.2	48.4	51.8	59.3	65.0	69.6	73.1	75.4	75.9	76.5	77.1

System, Lift 69.5 ft, Valve Speed 1 Min (Constant Speed Gate Opening), Upper Pool El 76.5,

T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=660	T=720	T=780	T=840	T=900	T=1020	T=1200
75.3	75.3	75.3	76.5	75.9	75.9	75.9	75.9	76.5	75.9	76.5	75.9	76.5	75.9
50.9	60.0	66.8	71.9	75.4	77.1	77.6	77.1	76.5	76.5	76.5	76.5	76.5	76.5
7.0	7.0	7.0	6.4	6.4	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.6
74.2	74.8	75.4	75.9	75.9	75.9	76.5	76.5	76.5	77.1	76.5	76.5	76.5	76.5
72.6	73.7	74.3	74.8	75.4	75.4	75.4	75.9	75.4	75.4	75.9	75.9	75.9	75.4
72.5	74.2	74.8	75.4	75.9	75.9	75.9	76.5	76.5	76.5	75.9	76.5	76.5	76.5
72.0	73.7	74.8	75.9	75.9	76.5	76.5	77.1	76.5	76.5	77.1	76.5	76.5	77.1
70.9	73.1	74.2	74.8	75.4	75.4	75.9	75.9	75.9	75.9	75.9	75.9	75.9	76.5
72.0	73.7	74.2	75.4	75.9	75.9	75.9	75.9	76.5	76.5	76.5	75.9	76.5	75.9
73.1	74.2	75.4	75.4	75.9	75.9	76.5	76.5	76.5	76.5	75.9	76.5	76.5	77.1
70.8	74.8	74.2	75.4	75.9	76.5	75.9	76.5	76.5	76.5	76.5	76.5	76.5	76.5
71.2	72.4	74.1	74.7	75.9	75.9	75.9	75.9	75.9	75.9	75.9	75.9	75.9	75.9
56.7	63.5	68.6	72.5	74.8	75.9	76.5	75.9	75.9	76.5	75.9	76.5	76.5	76.5
57.3	63.5	68.0	72.0	74.2	75.4	75.9	75.9	75.9	75.4	75.9	75.4	75.9	76.5
57.0	63.9	69.1	71.9	74.8	75.9	75.9	75.9	75.9	75.9	75.9	75.9	75.9	75.9
61.2	66.3	70.3	73.1	75.4	76.5	77.1	77.1	76.5	76.5	76.5	77.1	76.5	76.5
57.5	64.4	69.6	72.5	75.4	75.9	76.5	76.5	76.5	76.5	76.5	76.5	77.1	76.5
57.3	63.5	68.6	72.0	74.2	75.4	75.9	75.9	75.9	75.9	76.5	76.5	75.9	76.5
57.9	64.1	68.6	72.0	74.2	75.4	75.9	75.9	75.9	75.9	75.9	75.4	75.9	75.9
57.7	64.5	69.1	72.5	74.2	75.4	75.9	76.5	76.5	75.9	76.5	76.5	75.9	76.5
55.4	62.3	68.5	72.5	75.4	76.5	77.1	76.5	76.5	76.5	76.5	77.1	77.1	76.5
56.4	64.4	69.0	72.5	74.8	75.9	75.9	75.9	76.5	75.9	76.5	77.1	76.5	76.5
57.9	64.1	68.6	72.5	74.2	75.9	75.9	75.9	75.9	75.9	76.5	75.9	76.5	76.5
59.3	65.0	69.6	73.1	75.4	75.9	76.5	77.1	76.5	76.5	76.5	77.1	76.5	76.5

(Sheet 1 of 7)

Table 1 (Continued)

No.	Elev	T=0	T=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150
22	-37.0	7.0	8.1	4.2	9.8	29.8	36.6	39.5	42.3	44.6	48.6
23	-36.0	7.0	8.1	5.9	15.5	32.4	38.6	42.0	44.9	46.6	49.9
24	-35.0	7.0	8.7	7.6	15.5	34.7	40.9	44.9	46.6	48.8	52.2
25	-33.5	7.0	10.4	10.4	20.6	37.5	44.3	47.7	49.9	51.6	54.5
26	-32.0	7.0	13.9	12.2	19.6	36.9	43..8	47.8	50.7	53.0	55.2
27	-31.0	7.0	16.0	16.6	26.8	42.6	47.7	49.9	52.2	53.3	56.2
27A	-31.0	7.0	12.9	18.2	23.5	40.0	47.1	48.2	50.6	52.4	55.3
28	-42.0	7.0	14.5	19.1	27.7	40.9	47.8	50.7	53.0	54.1	57.0
29	-42.0	7.0	13.8	19.0	26.4	36.1	42.3	44.6	46.9	49.2	52.6
30	-42.0	7.0	14.7	19.4	28.8	42.3	50.0	52.9	54.7	55.9	58.2
31	-42.0	7.0	13.7	18.5	29.3	42.8	51.5	56.9	59.6	61.7	61.7
32	-53.0	7.0	15.0	20.2	28.8	40.9	46.6	49.5	51.8	53.5	56.4
33	-53.0	7.0	14.0	18.6	27.9	39.4	45.8	48.1	51.0	52.8	55.7
34	-53.0	7.0	13.3	18.5	28.3	39.2	44.9	47.8	50.7	52.4	55.2
35	-53.0	7.0	12.7	17.9	27.7	38.6	45.5	47.8	50.7	51.8	55.2
36	-53.0	7.0	11.8	16.0	25.0	35.2	41.8	45.9	48.9	51.3	54.9
36A	-53.0	7.0	11.1	16.8	26.1	37.1	43.5	47.0	49.8	51.0	54.5
37	-48.0	7.0	11.5	16.6	26.8	39.2	47.7	51.6	53.9	55.6	59.0
38	-36.0	7.0	12.2	16.3	26.1	37.7	46.4	49.3	51.6	53.3	56.2
39	-48.0	7.0	11.1	14.5	22.1	31.9	37.1	40.6	42.9	45.8	49.9
40	-36.0	7.0	10.5	11.6	13.4	14.0	18.0	19.2	22.6	26.1	33.1
41	-36.0	7.0	10.5	12.3	16.3	20.4	22.2	24.5	28.0	30.9	36.8
42	-36.0	7.0	8.8	11.7	16.4	20.0	21.7	23.5	27.6	28.8	35.9
43	-33.0	7.0	12.2	15.6	24.2	35.7	44.3	47.2	50.7	51.2	55.2
44	-37.0	7.0	11.0	15.6	23.7	34.6	44.3	47.8	50.7	51.8	55.8
45	-39.0	7.0	11.6	15.7	24.4	35.4	44.6	47.5	50.4	52.2	55.7

T=45	T=60	T=75	T=90	T=105	T=120	T=150	T=180	T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=660	T=720
9.8	29.8	36.6	39.5	42.3	44.6	48.6	52.6	59.4	65.7	69.7	73.1	74.8	75.9	76.5	76.5	76.5
15.5	32.4	38.6	42.0	44.9	46.6	49.9	53.9	60.7	65.8	69.7	73.1	74.8	75.9	75.9	75.9	75.9
15.5	34.7	40.9	44.9	46.6	48.8	52.2	56.2	61.8	67.5	70.8	73.1	75.4	76.5	76.5	76.5	76.5
20.6	37.5	44.3	47.7	49.9	51.6	54.5	57.3	62.9	67.5	70.3	73.7	74.8	75.9	75.9	75.9	75.9
19.6	36.9	43..8	47.8	50.7	53.0	55.2	58.7	63.9	68.5	70.8	73.6	74.8	75.9	75.9	75.9	75.9
26.8	42.6	47.7	49.9	52.2	53.3	56.2	59.5	64.1	68.6	71.4	74.2	75.4	76.5	75.9	76.5	75.9
23.5	40.0	47.1	48.2	50.6	52.4	55.3	58.2	63.5	68.3	71.8	74.1	75.9	76.5	77.1	76.5	76.5
27.7	40.9	47.8	50.7	53.0	54.1	57.0	59.8	64.4	69.0	71.9	74.2	75.9	76.5	76.5	76.5	76.5
26.4	36.1	42.3	44.6	46.9	49.2	52.6	56.0	62.3	66.8	70.8	73.7	75.4	75.9	76.5	75.9	75.9
28.8	42.3	50.0	52.9	54.7	55.9	58.2	61.8	65.9	70.0	73.0	74.7	76.5	76.5	76.5	76.5	76.5
29.3	42.8	51.5	56.9	59.6	61.7	61.7	61.0	61.7	68.4	70.4	73.1	75.2	75.8	76.5	75.8	76.5
28.8	40.9	46.6	49.5	51.8	53.5	56.4	59.3	64.4	68.5	71.3	74.2	75.4	75.9	75.9	75.9	76.5
27.9	39.4	45.8	48.1	51.0	52.8	55.7	59.1	64.3	68.4	71.9	73.6	75.9	76.5	77.1	75.9	76.5
28.3	39.2	44.9	47.8	50.7	52.4	55.2	58.7	63.9	68.5	72.5	74.8	76.5	77.1	77.1	77.1	76.5
27.7	38.6	45.5	47.8	50.7	51.8	55.2	58.1	63.9	68.5	71.9	74.8	75.9	77.1	77.1	76.5	76.5
25.0	35.2	41.8	45.9	48.9	51.3	54.9	58.5	63.9	68.7	72.3	73.5	75.9	76.5	76.5	75.9	75.9
26.1	37.1	43.5	47.0	49.8	51.0	54.5	57.4	63.2	69.0	71.9	74.2	75.9	76.5	77.1	76.5	76.5
26.8	39.2	47.7	51.6	53.9	55.6	59.0	61.2	65.8	70.3	73.1	74.8	76.5	77.1	77.1	76.5	76.5
26.1	37.7	46.4	49.3	51.6	53.3	56.2	59.7	64.9	69.0	72.4	74.8	76.5	77.1	77.1	77.1	76.5
22.1	31.9	37.1	40.6	42.9	45.8	49.9	53.9	60.9	66.1	71.3	74.2	75.9	77.1	77.1	76.5	76.5
13.4	14.0	18.0	19.2	22.6	26.1	33.1	40.0	51.0	60.9	66.7	71.9	75.3	77.7	77.7	76.5	76.5
16.3	20.4	22.2	24.5	28.0	30.9	36.8	43.2	53.1	60.7	67.7	71.8	75.3	76.5	76.5	76.5	75.3
16.4	20.0	21.7	23.5	27.6	28.8	35.9	42.3	51.8	60.0	67.1	71.8	74.7	76.5	77.1	75.9	75.9
24.2	35.7	44.3	47.2	50.7	51.2	55.2	58.7	63.9	67.9	71.9	74.8	75.9	76.5	77.1	76.5	76.5
23.7	34.6	44.3	47.8	50.7	51.8	55.8	58.7	63.9	67.9	71.9	74.2	76.5	77.1	77.1	75.9	75.9
24.4	35.4	44.6	47.5	50.4	52.2	55.7	58.5	64.3	67.8	71.3	74.2	75.9	76.5	76.5	75.9	75.9

180	T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=660	T=720	T=780	T=840	T=900	T=1020	T=1200
.6	59.4	65.7	69.7	73.1	74.8	75.9	76.5	76.5	76.5	76.5	75.9	76.5	75.9	76.5
.9	60.7	65.8	69.7	73.1	74.8	75.9	75.9	75.9	75.9	75.9	75.9	75.9	75.9	76.5
.2	61.8	67.5	70.8	73.1	75.4	76.5	76.5	76.5	76.5	75.9	75.9	75.9	75.9	76.5
.3	62.9	67.5	70.3	73.7	74.8	75.9	75.9	75.9	75.9	75.9	75.9	75.9	75.9	76.5
.7	63.9	68.5	70.8	73.6	74.8	75.9	75.9	75.9	75.9	75.9	75.9	75.9	76.5	76.5
.5	64.1	68.6	71.4	74.2	75.4	76.5	75.9	76.5	75.9	75.9	75.9	76.5	75.9	76.5
.2	63.5	68.3	71.8	74.1	75.9	76.5	77.1	76.5	76.5	76.5	76.5	77.1	77.1	76.5
.8	64.4	69.0	71.9	74.2	75.9	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5	76.5
.0	62.3	66.8	70.8	73.7	75.4	75.9	76.5	75.9	75.9	75.9	75.9	75.9	76.5	76.5
.8	65.9	70.0	73.0	74.7	76.5	76.5	76.5	76.5	76.5	76.5	76.5	77.1	76.5	76.5
.0	61.7	68.4	70.4	73.1	75.2	75.8	76.5	75.8	76.5	75.8	76.5	76.5	76.5	76.5
.3	64.4	68.5	71.3	74.2	75.4	75.9	75.9	75.9	76.5	75.9	76.5	75.9	76.5	76.5
.1	64.3	68.4	71.9	73.6	75.9	76.5	77.1	75.9	76.5	75.9	77.1	76.5	77.1	76.5
.7	63.9	68.5	72.5	74.8	76.5	77.1	77.1	77.1	76.5	77.1	77.1	77.1	77.1	76.5
.1	63.9	68.5	71.9	74.8	75.9	77.1	77.1	76.5	76.5	76.5	77.1	76.5	76.5	76.5
.5	63.9	68.7	72.3	73.5	75.9	76.5	76.5	75.9	75.9	76.5	76.5	76.5	76.5	76.5
.4	63.2	69.0	71.9	74.2	75.9	76.5	77.1	76.5	76.5	76.5	77.1	76.5	76.5	76.5
.2	65.8	70.3	73.1	74.8	76.5	77.1	77.1	76.5	76.5	76.5	76.5	76.5	76.5	76.5
.7	64.9	69.0	72.4	74.8	76.5	77.1	77.1	77.1	76.5	76.5	76.5	77.1	77.1	76.5
.9	60.9	66.1	71.3	74.2	75.9	77.1	77.1	76.5	76.5	76.5	77.1	77.1	77.1	76.5
.0	51.0	60.9	66.7	71.9	75.3	77.7	77.7	76.5	76.5	76.5	76.5	77.1	77.1	76.5
.2	53.1	60.7	67.7	71.8	75.3	76.5	76.5	76.5	75.3	75.9	75.9	76.5	76.5	76.5
.3	51.8	60.0	67.1	71.8	74.7	76.5	77.1	75.9	75.9	75.9	76.5	76.5	76.5	76.5
.7	63.9	67.9	71.9	74.8	75.9	76.5	77.1	76.5	76.5	75.9	76.5	77.1	76.5	76.5
.7	63.9	67.9	71.9	74.2	76.5	77.1	77.1	75.9	75.9	76.5	76.5	77.1	76.5	76.5
.5	64.3	67.8	71.3	74.2	75.9	76.5	76.5	75.9	75.9	75.9	76.5	76.5	75.9	76.5

(Sheet 2 of 7)

Table 1 (Continued)

No.	Elev	T=0	T=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150
46	-35.0	7.0	11.6	16.1	24.7	35.5	44.0	47.4	50.9	52.0	55.4
47	-35.0	7.0	10.5	15.1	24.4	36.5	44.6	48.1	50.4	52.8	56.2
48	-36.0	7.0	10.5	15.8	25.8	37.6	46.5	50.0	52.4	54.7	57.7
49	-36.0	7.0	11.1	15.7	26.1	38.3	45.2	49.9	52.2	53.9	57.4
50	-31.0	7.0	10.9	14.1	21.8	26.9	30.8	34.7	37.9	39.8	44.3
51	-42.0	7.0	11.0	13.9	21.4	30.0	35.1	38.0	41.5	43.8	47.8
52	-27.8	7.0	11.1	14.5	22.1	30.7	35.4	37.1	41.8	42.9	47.5
53	-49.5	7.0	11.0	15.6	23.7	35.1	42.6	46.6	48.9	50.7	54.1
54	-21.6	—	—	—	—	—	—	—	—	—	—
55	-41.6	7.0	11.0	14.4	22.4	32.1	37.8	41.8	44.6	46.3	50.3
56	-17.5	7.0	10.5	14.1	22.3	32.3	40.0	42.9	45.3	47.6	51.2
57	-35.2	7.0	8.8	11.8	19.5	27.2	33.1	36.1	39.7	41.5	46.8
58	-31.3	7.0	8.2	11.2	17.8	26.2	33.4	35.8	39.4	41.8	46.5
59	-31.3	7.0	9.8	13.3	19.5	28.6	34.3	38.9	41.8	43.5	48.6
60	-23.1	—	—	—	—	—	—	—	—	—	—
61	-23.1	7.0	9.3	12.7	20.1	29.8	36.1	41.2	44.0	46.3	50.3
62	-22.8	7.0	8.2	9.9	12.8	16.9	20.4	23.9	26.9	30.9	37.4
63	-22.8	7.0	9.3	12.7	20.2	30.0	36.9	41.5	44.3	46.6	50.7
64	-22.4	7.0	8.2	9.9	12.8	15.7	20.3	23.2	26.1	30.2	36.5
65	-22.4	7.0	9.3	12.2	19.1	28.3	36.9	41.5	43.8	46.1	50.7
66	-28.0	7.0	7.6	10.4	14.5	20.8	26.0	30.0	32.8	36.3	41.5
66A	-28.0	7.0	8.2	10.5	15.7	22.6	27.3	31.9	36.0	38.9	44.1
67	-28.0	7.0	8.2	11.1	15.7	23.2	29.0	32.5	36.0	38.3	44.1
68	-28.0	7.0	8.2	11.1	18.0	27.3	34.2	38.3	41.8	43.5	48.7
69	-28.0	7.0	8.1	11.6	18.5	28.8	36.9	40.3	43.8	46.1	50.7
70	-28.0	7.0	8.2	11.6	20.3	30.7	40.6	43.5	45.8	48.1	52.8

d)

T=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150	T=180	T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=6
11.6	16.1	24.7	35.5	44.0	47.4	50.9	52.0	55.4	58.3	64.0	68.0	71.4	74.2	75.4	76.5	76.5	76
10.5	15.1	24.4	36.5	44.6	48.1	50.4	52.8	56.2	59.1	64.3	68.4	71.9	74.2	75.3	76.5	76.5	76
10.5	15.8	25.8	37.6	46.5	50.0	52.4	54.7	57.7	60.0	64.7	68.8	72.4	74.1	75.9	76.5	76.5	76
11.1	15.7	26.1	38.3	45.2	49.9	52.2	53.9	57.4	59.7	64.3	68.4	71.9	74.2	75.3	76.5	76.5	76
10.9	14.1	21.8	26.9	30.8	34.7	37.9	39.8	44.3	48.8	57.2	63.0	68.8	72.0	75.2	75.9	76.5	75
11.0	13.9	21.4	30.0	35.1	38.0	41.5	43.8	47.8	52.4	58.7	65.6	70.2	73.6	75.9	77.1	77.1	75
11.1	14.5	22.1	30.7	35.4	37.1	41.8	42.9	47.5	51.6	59.7	65.5	70.1	73.6	75.3	77.1	77.7	76
11.0	15.6	23.7	35.1	42.6	46.6	48.9	50.7	54.1	57.0	63.3	67.3	71.3	74.2	75.9	77.1	77.1	75
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
11.0	14.4	22.4	32.1	37.8	41.8	44.6	46.3	50.3	54.3	61.1	66.8	70.8	73.7	75.9	77.1	77.1	76
10.5	14.1	22.3	32.3	40.0	42.9	45.3	47.6	51.2	54.7	61.2	66.5	70.6	73.6	75.3	77.1	77.1	75
8.8	11.8	19.5	27.2	33.1	36.1	39.7	41.5	46.8	51.0	58.7	65.2	70.0	73.5	75.9	77.1	77.1	76
8.2	11.2	17.8	26.2	33.4	35.8	39.4	41.8	46.5	50.7	58.5	65.1	69.9	73.5	75.9	77.1	77.1	76
9.8	13.3	19.5	28.6	34.3	38.9	41.8	43.5	48.6	52.0	59.4	65.7	70.2	74.2	75.9	77.1	77.1	75
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9.3	12.7	20.1	29.8	36.1	41.2	44.0	46.3	50.3	53.7	61.1	66.2	70.8	74.2	75.9	77.1	77.1	76
8.2	9.9	12.8	16.9	20.4	23.9	26.9	30.9	37.4	42.6	53.7	61.9	67.7	73.0	75.9	77.7	77.1	77
9.3	12.7	20.2	30.0	36.9	41.5	44.3	46.6	50.7	54.1	61.0	66.7	70.8	74.2	75.9	77.6	77.1	76
8.2	9.9	12.8	15.7	20.3	23.2	26.1	30.2	36.5	42.3	52.2	61.4	67.8	72.4	75.9	77.7	77.1	76
9.3	12.2	19.1	28.3	36.9	41.5	43.8	46.1	50.7	54.1	60.4	66.7	70.2	74.2	75.9	77.1	77.1	76
7.6	10.4	14.5	20.8	26.0	30.0	32.8	36.3	41.5	46.6	55.8	63.9	68.5	72.5	75.9	77.1	77.6	76
8.2	10.5	15.7	22.6	27.3	31.9	36.0	38.9	44.1	49.3	57.4	64.9	70.1	74.2	76.5	77.7	77.7	77
8.2	11.1	15.7	23.2	29.0	32.5	36.0	38.3	44.1	48.7	57.4	63.8	69.6	73.0	75.3	76.5	77.1	75
8.2	11.1	18.0	27.3	34.2	38.3	41.8	43.5	48.7	52.8	59.7	66.1	70.7	74.2	75.9	77.7	77.1	76
8.1	11.6	18.5	28.8	36.9	40.3	43.8	46.1	50.7	54.7	61.0	67.3	70.8	74.2	76.5	77.6	77.6	76
8.2	11.6	20.3	30.7	40.6	43.5	45.8	48.1	52.8	55.7	62.6	67.2	71.3	74.2	76.5	77.7	77.7	76

T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=660	T=720	T=780	T=840	T=900	T=1020	T=1200
64.0	68.0	71.4	74.2	75.4	76.5	76.5	76.5	75.9	75.9	76.5	76.5	76.5	76.5
64.3	68.4	71.9	74.2	75.3	76.5	76.5	76.5	76.5	75.9	76.5	77.1	75.9	76.5
64.7	68.8	72.4	74.1	75.9	76.5	76.5	76.5	75.9	76.5	76.5	77.1	77.1	76.5
64.3	68.4	71.9	74.2	75.3	76.5	76.5	76.5	75.3	75.9	75.9	76.5	75.9	76.5
57.2	63.0	68.8	72.0	75.2	75.9	76.5	75.9	75.2	75.9	75.9	76.5	75.9	76.5
58.7	65.6	70.2	73.6	75.9	77.1	77.1	75.9	76.5	75.9	76.5	76.5	76.5	76.5
59.7	65.5	70.1	73.6	75.3	77.1	77.7	76.5	75.9	76.5	76.5	77.1	76.5	76.5
63.3	67.3	71.3	74.2	75.9	77.1	77.1	75.9	75.9	75.9	76.5	76.5	76.5	76.5
—	—	—	—	—	—	—	—	—	—	—	—	—	—
61.1	66.8	70.8	73.7	75.9	77.1	77.1	76.5	75.9	75.9	75.9	77.1	77.1	76.5
61.2	66.5	70.6	73.6	75.3	77.1	77.1	75.9	75.9	75.9	75.9	75.9	76.5	76.5
58.7	65.2	70.0	73.5	75.9	77.1	77.1	76.5	75.9	76.5	76.5	77.1	76.5	76.5
58.5	65.1	69.9	73.5	75.9	77.1	77.1	76.5	75.9	75.9	76.5	77.1	76.5	76.5
59.4	65.7	70.2	74.2	75.9	77.1	77.1	75.9	75.9	75.9	75.9	76.5	76.5	76.5
—	—	—	—	—	—	—	—	—	—	—	—	—	—
61.1	66.2	70.8	74.2	75.9	77.1	77.1	76.5	75.4	75.9	75.9	76.5	75.9	76.5
53.7	61.9	67.7	73.0	75.9	77.7	77.1	77.1	75.9	75.9	77.1	77.7	77.1	76.5
61.0	66.7	70.8	74.2	75.9	77.6	77.1	76.5	75.9	75.9	76.5	76.5	77.1	76.5
52.2	61.4	67.8	72.4	75.9	77.7	77.1	76.5	75.3	75.3	75.9	76.5	75.9	76.5
60.4	66.7	70.2	74.2	75.9	77.1	77.1	76.5	75.4	75.9	75.9	76.5	76.5	76.5
55.8	63.9	68.5	72.5	75.9	77.1	77.6	76.5	75.9	75.9	76.5	76.5	76.5	76.5
57.4	64.9	70.1	74.2	76.5	77.7	77.7	77.1	75.9	76.5	77.1	77.7	77.1	76.5
57.4	63.8	69.6	73.0	75.3	76.5	77.1	75.9	75.3	75.9	76.5	76.5	75.9	76.5
59.7	66.1	70.7	74.2	75.9	77.7	77.1	76.5	75.9	75.9	76.5	77.1	77.1	76.5
61.0	67.3	70.8	74.2	76.5	77.6	77.6	76.5	75.4	75.9	76.5	77.1	76.5	76.5
62.6	67.2	71.3	74.2	76.5	77.7	77.7	76.5	75.9	75.9	75.9	77.1	76.5	76.5

(Sheet 3 of 7)

Table 1 (Continued)

No.	Elev.	T=0	T=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150	T
71	-28.0	7.0	8.1	12.1	20.7	32.1	40.6	44.0	46.9	49.2	53.7	5
72	-28.0	7.0	9.3	12.8	20.3	28.4	35.4	39.4	42.9	44.1	48.7	5
73	-23.5	7.0	8.7	10.4	12.7	15.0	16.2	20.8	24.2	27.7	34.6	4
74	-23.5	7.0	8.7	11.0	14.4	19.0	23.5	26.4	30.9	33.2	39.5	4
75	-22.8	7.0	9.3	12.1	17.2	24.0	29.6	32.4	36.9	39.2	44.3	4
76	-28.0	7.0	8.7	11.0	15.5	20.7	25.8	28.6	33.2	35.5	41.8	4
76A	-28.0	7.0	8.2	9.3	12.8	18.0	22.1	26.7	30.2	33.1	39.4	4
77	-28.0	7.0	7.6	11.1	16.3	23.8	29.6	33.6	37.7	39.4	44.6	4
78	-28.0	7.0	8.1	11.0	17.3	26.4	33.8	37.8	41.2	44.0	48.0	5
79	-28.0	7.0	7.6	11.6	18.5	29.4	36.9	41.5	44.9	47.2	51.8	5
80	-28.0	7.0	7.6	11.6	19.7	30.7	39.4	44.6	47.0	49.3	52.2	5
81	-28.0	7.0	7.6	12.4	19.6	30.4	38.8	43.5	46.5	48.9	53.1	5
81A	-28.0	7.0	8.2	12.8	20.9	32.5	40.0	44.1	46.4	49.3	52.8	5
82	-22.8	7.0	8.8	11.7	15.8	21.1	24.1	30.0	31.7	34.7	41.2	4
83	-22.8	7.0	9.3	13.4	19.8	28.0	32.1	35.6	38.0	40.3	45.5	5
84	-22.8	7.0	9.3	11.6	16.3	21.5	26.1	29.6	32.5	35.4	41.8	4
85	-22.8	—	—	—	—	—	—	—	—	—	—	-
86	-25.5	—	—	—	—	—	—	—	—	—	—	-
87	-48.0	7.0	13.4	15.2	21.0	25.1	26.9	30.4	32.1	36.2	40.3	4
88	-36.0	7.0	14.4	20.1	33.2	42.3	44.6	47.4	49.2	49.7	54.3	5
89	-48.0	7.0	13.5	19.4	32.3	46.5	50.0	51.2	53.5	54.7	58.2	6
90	-48.0	7.0	13.4	19.3	33.3	47.3	50.8	53.1	54.9	55.5	59.6	6
91	-48.0	7.0	14.5	20.8	35.1	48.4	50.7	53.0	54.1	55.8	58.7	6
92	-36.0	7.0	11.5	16.6	25.6	39.2	47.1	48.8	51.1	52.2	55.6	5
93	-36.0	7.0	11.6	16.8	26.0	38.6	44.9	46.6	49.5	50.1	54.1	5
94	-36.0	7.0	10.4	14.3	20.6	29.6	36.9	40.3	43.2	45.4	49.4	5

d)

T=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150	T=180	T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=
8.1	12.1	20.7	32.1	40.6	44.0	46.9	49.2	53.7	56.6	62.8	65.7	71.9	74.2	76.5	77.1	77.1	7
9.3	12.8	20.3	28.4	35.4	39.4	42.9	44.1	48.7	53.3	60.3	67.2	71.3	74.2	76.5	77.1	77.1	7
8.7	10.4	12.7	15.0	16.2	20.8	24.2	27.7	34.6	40.9	52.4	60.4	67.3	71.9	75.9	77.1	77.1	7
8.7	11.0	14.4	19.0	23.5	26.4	30.9	33.2	39.5	44.6	54.9	62.3	68.0	73.1	75.4	77.1	77.1	7
9.3	12.1	17.2	24.0	29.6	32.4	36.9	39.2	44.3	49.4	57.3	64.1	69.2	73.1	75.9	77.1	77.1	7
8.7	11.0	15.5	20.7	25.8	28.6	33.2	35.5	41.8	47.4	56.0	63.4	69.7	73.7	75.9	78.2	78.2	7
8.2	9.3	12.8	18.0	22.1	26.7	30.2	33.1	39.4	44.6	53.9	62.0	67.8	73.0	75.3	77.1	77.1	7
7.6	11.1	16.3	23.8	29.6	33.6	37.7	39.4	44.6	49.3	58.0	64.9	70.1	73.6	75.9	77.7	77.7	7
8.1	11.0	17.3	26.4	33.8	37.8	41.2	44.0	48.0	52.0	59.4	65.7	70.2	73.7	75.4	76.5	77.1	7
7.6	11.6	18.5	29.4	36.9	41.5	44.9	47.2	51.8	54.7	61.6	67.3	71.3	74.2	75.9	77.1	77.6	7
7.6	11.6	19.7	30.7	39.4	44.6	47.0	49.3	52.2	56.2	62.0	67.2	71.3	74.2	75.9	76.5	77.1	7
7.6	12.4	19.6	30.4	38.8	43.5	46.5	48.9	53.1	56.7	62.7	67.5	70.5	73.5	75.3	76.5	76.5	7
8.2	12.8	20.9	32.5	40.0	44.1	46.4	49.3	52.8	55.7	62.6	67.2	71.9	74.8	76.5	77.7	77.7	7
8.8	11.7	15.8	21.1	24.1	30.0	31.7	34.7	41.2	47.1	55.9	63.0	68.8	73.0	75.9	77.1	77.1	7
9.3	13.4	19.8	28.0	32.1	35.6	38.0	40.3	45.5	50.8	58.4	64.8	70.1	74.2	76.5	77.7	77.7	7
9.3	11.6	16.3	21.5	26.1	29.6	32.5	35.4	41.8	45.8	55.1	62.6	69.0	73.0	75.3	77.1	77.1	7
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	-
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	-
13.4	15.2	21.0	25.1	26.9	30.4	32.1	36.2	40.3	46.7	56.1	63.1	68.9	71.8	74.7	76.5	77.7	7
14.4	20.1	33.2	42.3	44.6	47.4	49.2	49.7	54.3	57.7	64.0	68.5	71.9	74.2	76.5	77.1	77.1	7
13.5	19.4	32.3	46.5	50.0	51.2	53.5	54.7	58.2	60.6	64.7	69.4	72.4	74.7	75.9	76.5	77.1	7
13.4	19.3	33.3	47.3	50.8	53.1	54.9	55.5	59.6	61.9	66.0	70.1	73.0	75.3	76.5	77.1	77.1	7
14.5	20.8	35.1	48.4	50.7	53.0	54.1	55.8	58.7	61.0	65.6	69.6	73.1	74.8	76.5	77.1	77.1	7
11.5	16.6	25.6	39.2	47.1	48.8	51.1	52.2	55.6	59.5	64.6	68.6	72.0	74.8	76.5	77.1	77.6	7
11.6	16.8	26.0	38.6	44.9	46.6	49.5	50.1	54.1	58.1	62.7	67.9	71.3	73.6	75.9	76.5	77.1	7
10.4	14.3	20.6	29.6	36.9	40.3	43.2	45.4	49.4	53.3	60.7	65.8	70.3	73.1	75.9	77.1	77.1	7

30	T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=660	T=720	T=780	T=840	T=900	T=1020	T=1200
6	62.8	65.7	71.9	74.2	76.5	77.1	77.1	75.9	75.4	75.9	76.5	77.1	76.5	76.5
3	60.3	67.2	71.3	74.2	76.5	77.1	77.1	76.5	75.9	75.9	76.5	77.1	77.1	76.5
9	52.4	60.4	67.3	71.9	75.9	77.1	77.1	76.5	75.9	75.4	76.5	76.5	76.5	76.5
6	54.9	62.3	68.0	73.1	75.4	77.1	77.1	75.9	75.4	75.9	76.5	76.5	76.5	76.5
4	57.3	64.1	69.2	73.1	75.9	77.1	77.1	75.9	75.4	75.9	76.5	76.5	76.5	76.5
4	56.0	63.4	69.7	73.7	75.9	78.2	78.2	76.5	76.5	76.5	77.1	77.1	77.1	76.5
6	53.9	62.0	67.8	73.0	75.3	77.1	77.1	75.9	75.9	75.9	75.9	76.5	76.5	76.5
3	58.0	64.9	70.1	73.6	75.9	77.7	77.7	77.1	76.5	75.9	77.1	77.1	76.5	76.5
0	59.4	65.7	70.2	73.7	75.4	76.5	77.1	75.9	74.8	75.4	75.9	76.5	76.5	76.5
7	61.6	67.3	71.3	74.2	75.9	77.1	77.6	77.1	75.9	75.9	77.1	77.1	76.5	76.5
2	62.0	67.2	71.3	74.2	75.9	76.5	77.1	76.5	74.8	75.3	75.9	77.1	76.5	76.5
7	62.7	67.5	70.5	73.5	75.3	76.5	76.5	75.9	75.3	75.3	76.5	76.5	76.5	76.5
7	62.6	67.2	71.9	74.8	76.5	77.7	77.7	77.1	75.9	76.5	77.1	77.7	77.1	76.5
1	55.9	63.0	68.8	73.0	75.9	77.1	77.1	76.5	75.9	75.9	76.5	76.5	76.5	76.5
8	58.4	64.8	70.1	74.2	76.5	77.7	77.7	76.5	75.9	75.9	76.5	77.1	77.1	76.5
8	55.1	62.6	69.0	73.0	75.3	77.1	77.1	75.9	75.9	75.9	76.5	76.5	75.9	76.5
	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—
7	56.1	63.1	68.9	71.8	74.7	76.5	77.7	76.5	76.5	76.5	77.1	77.1	76.5	76.5
7	64.0	68.5	71.9	74.2	76.5	77.1	77.1	76.5	75.9	75.9	76.5	76.5	76.5	76.5
5	64.7	69.4	72.4	74.7	75.9	76.5	77.1	76.5	75.9	76.5	76.5	76.5	76.5	76.5
9	66.0	70.1	73.0	75.3	76.5	77.1	77.1	77.1	76.5	75.9	76.5	76.5	76.5	76.5
0	65.6	69.6	73.1	74.8	76.5	77.1	77.1	76.5	75.9	75.9	76.5	77.1	76.5	76.5
5	64.6	68.6	72.0	74.8	76.5	77.1	77.6	77.1	76.5	75.9	76.5	77.1	76.5	76.5
1	62.7	67.9	71.3	73.6	75.9	76.5	77.1	76.5	75.9	75.9	76.5	76.5	75.9	76.5
3	60.7	65.8	70.3	73.1	75.9	77.1	77.1	76.5	75.9	75.9	75.9	76.5	76.5	76.5

(Sheet 4 of 7)

Table 1 (Continued)

No.	Elev	T=0	T=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150
95	-48.0	7.0	9.8	14.3	21.0	32.2	41.8	45.7	49.0	50.7	54.1
96	-48.0	7.0	9.3	13.8	20.7	32.1	41.8	45.7	48.6	50.3	53.7
97	-48.0	7.0	9.9	13.9	19.1	27.7	34.6	39.7	42.6	45.5	49.5
98	-31.0	7.0	7.0	7.6	8.8	10.6	13.6	17.3	21.5	25.1	33.0
99	-42.0	7.0	9.3	12.7	17.8	26.4	31.5	35.5	38.9	41.8	46.3
100	-27.8	7.0	9.9	13.4	18.6	26.7	32.5	36.5	39.4	42.3	47.0
101	-49.5	7.0	9.3	13.8	21.2	32.6	41.8	46.3	48.0	50.9	54.3
102	-21.6	7.0	9.2	13.2	19.3	28.3	35.0	39.5	42.3	44.6	49.0
103	-41.6	7.0	9.3	13.3	19.1	28.3	35.7	40.3	43.2	44.9	49.5
104	-17.5	7.0	9.3	12.7	19.1	28.8	36.3	40.9	43.8	46.1	50.7
105	-35.2	7.0	9.8	12.1	18.3	25.1	31.3	35.3	38.6	40.3	45.4
106	-31.3	7.0	8.7	11.5	17.2	25.6	33.0	36.9	40.3	43.2	47.1
107	-31.3	7.0	8.1	11.0	16.2	24.8	32.3	36.9	40.3	43.2	47.2
108	-23.1	7.0	8.1	9.8	13.2	17.7	21.7	25.6	28.5	31.9	38.1
109	-23.1	7.0	8.7	11.0	17.3	26.4	33.8	38.9	42.3	44.6	49.2
110	-22.8	7.0	8.7	9.9	12.8	18.0	22.1	26.7	29.6	32.5	38.9
111	-22.8	7.0	7.6	10.4	16.1	25.2	33.8	38.9	42.9	45.2	49.2
112	-22.4	7.0	8.7	10.4	13.3	17.3	22.5	26.0	30.0	32.8	38.6
113	-22.4	7.0	8.7	12.0	17.6	26.6	35.0	39.5	43.4	45.7	50.2
114	-28.0	7.0	8.1	9.8	13.2	17.7	22.8	26.8	30.2	34.1	39.2
114A	-28.0	7.0	8.2	9.9	13.5	18.2	22.3	27.0	30.0	33.5	39.4
115	-28.0	7.0	7.0	9.3	13.3	19.6	26.0	30.5	33.4	36.9	42.6
116	-28.0	7.0	7.6	9.8	14.4	21.2	27.5	32.6	36.6	39.5	45.2
117	-28.0	7.0	7.0	9.8	14.9	24.0	32.4	36.9	40.3	43.2	47.7
118	-28.0	7.0	7.6	10.4	16.0	25.6	35.3	39.2	43.2	45.4	50.5
119	-28.0	7.0	7.6	11.0	16.7	26.4	36.1	41.2	44.0	46.3	50.9

d)

T=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150	T=180	T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=6
9.8	14.3	21.0	32.2	41.8	45.7	49.0	50.7	54.1	57.4	63.0	67.5	71.5	73.7	75.9	76.5	77.1	76
9.3	13.8	20.7	32.1	41.8	45.7	48.6	50.3	53.7	57.1	62.8	67.4	71.4	74.2	76.5	77.6	77.6	77
9.9	13.9	19.1	27.7	34.6	39.7	42.6	45.5	49.5	54.1	60.4	66.2	69.6	73.6	75.4	77.1	77.1	76
7.0	7.6	8.8	10.6	13.6	17.3	21.5	25.1	33.0	39.0	49.3	57.2	67.4	71.7	74.1	75.9	76.5	75
9.3	12.7	17.8	26.4	31.5	35.5	38.9	41.8	46.3	51.4	58.8	64.5	69.7	73.1	75.9	77.1	77.1	77
9.9	13.4	18.6	26.7	32.5	36.5	39.4	42.3	47.0	51.0	59.1	64.9	70.1	73.6	75.9	77.1	77.1	77
9.3	13.8	21.2	32.6	41.8	46.3	48.0	50.9	54.3	57.7	63.4	68.0	71.9	74.8	76.5	77.6	77.6	77
9.2	13.2	19.3	28.3	35.0	39.5	42.3	44.6	49.0	53.0	60.2	65.3	70.3	73.1	75.9	77.1	77.1	77
9.3	13.3	19.1	28.3	35.7	40.3	43.2	44.9	49.5	54.1	61.0	66.2	70.8	74.2	76.5	77.6	77.6	77
9.3	12.7	19.1	28.8	36.3	40.9	43.8	46.1	50.7	54.7	61.0	66.2	71.3	74.2	76.5	77.6	77.6	77
9.8	12.1	18.3	25.1	31.3	35.3	38.6	40.3	45.4	50.5	57.9	64.6	69.7	73.1	75.4	76.5	77.1	76
8.7	11.5	17.2	25.6	33.0	36.9	40.3	43.2	47.1	51.6	59.5	65.2	69.7	73.7	75.9	77.6	78.2	77
8.1	11.0	16.2	24.8	32.3	36.9	40.3	43.2	47.2	51.8	59.3	65.0	69.6	73.6	75.9	77.1	77.1	76
8.1	9.8	13.2	17.7	21.7	25.6	28.5	31.9	38.1	43.7	53.3	61.8	67.5	72.5	75.4	77.1	77.1	77
8.7	11.0	17.3	26.4	33.8	38.9	42.3	44.6	49.2	52.6	60.0	65.7	69.7	73.7	75.9	77.6	77.6	77
8.7	9.9	12.8	18.0	22.1	26.7	29.6	32.5	38.9	44.6	53.9	61.4	67.8	72.4	75.9	77.1	77.7	76
7.6	10.4	16.1	25.2	33.8	38.9	42.9	45.2	49.2	53.7	60.5	66.2	70.8	74.2	76.5	77.6	77.6	77
8.7	10.4	13.3	17.3	22.5	26.0	30.0	32.8	38.6	44.3	54.1	62.1	67.9	73.1	75.4	77.1	78.2	77
8.7	12.0	17.6	26.6	35.0	39.5	43.4	45.7	50.2	53.5	60.8	66.4	70.9	73.7	76.5	77.1	77.6	77
8.1	9.8	13.2	17.7	22.8	26.8	30.2	34.1	39.2	44.9	54.5	62.4	68.0	73.1	75.9	77.6	78.2	77
8.2	9.9	13.5	18.2	22.3	27.0	30.0	33.5	39.4	44.7	54.1	61.8	68.3	72.4	75.3	76.5	77.1	76
7.0	9.3	13.3	19.6	26.0	30.5	33.4	36.9	42.6	47.2	55.8	63.3	69.0	73.6	75.9	77.6	78.2	77
7.6	9.8	14.4	21.2	27.5	32.6	36.6	39.5	45.2	49.2	57.7	64.0	69.1	73.1	75.9	77.6	77.6	77
7.0	9.8	14.9	24.0	32.4	36.9	40.3	43.2	47.7	51.1	59.0	65.2	69.7	73.7	75.9	77.6	77.6	77
7.6	10.4	16.0	25.6	35.3	39.2	43.2	45.4	50.5	53.9	61.2	66.3	70.8	73.7	76.5	78.2	77.6	77
7.6	11.0	16.7	26.4	36.1	41.2	44.0	46.3	50.9	54.9	61.7	66.2	71.4	74.8	77.1	78.2	78.2	77

80	T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=660	T=720	T=780	T=840	T=900	T=1020	T=1200
4	63.0	67.5	71.5	73.7	75.9	76.5	77.1	76.5	75.9	75.4	75.9	75.9	76.5	76.5
1	62.8	67.4	71.4	74.2	76.5	77.6	77.6	77.1	75.9	75.9	75.9	76.5	76.5	76.5
1	60.4	66.2	69.6	73.6	75.4	77.1	77.1	76.5	75.9	75.9	75.9	76.5	76.5	76.5
0	49.3	57.2	67.4	71.7	74.1	75.9	76.5	75.9	75.3	74.7	75.3	75.9	77.1	76.5
4	58.8	64.5	69.7	73.1	75.9	77.1	77.1	77.1	76.5	75.9	76.5	76.5	76.5	76.5
0	59.1	64.9	70.1	73.6	75.9	77.1	77.1	77.1	75.9	75.9	76.5	76.5	76.5	76.5
7	63.4	68.0	71.9	74.8	76.5	77.6	77.6	77.1	76.5	76.5	76.5	77.1	77.1	76.5
0	60.2	65.3	70.3	73.1	75.9	77.1	77.1	77.1	75.9	75.9	75.9	76.5	76.5	76.5
1	61.0	66.2	70.8	74.2	76.5	77.6	77.6	77.1	77.1	76.5	76.5	77.1	77.1	76.5
7	61.0	66.2	71.3	74.2	76.5	77.6	77.6	77.1	77.1	76.5	77.1	77.1	77.1	76.5
5	57.9	64.6	69.7	73.1	75.4	76.5	77.1	76.5	75.9	75.9	75.9	76.5	76.5	76.5
6	59.5	65.2	69.7	73.7	75.9	77.6	78.2	77.1	75.9	76.5	76.5	77.1	76.5	76.5
8	59.3	65.0	69.6	73.6	75.9	77.1	77.1	76.5	75.4	75.9	75.9	76.5	76.5	76.5
7	53.3	61.8	67.5	72.5	75.4	77.1	77.1	77.1	75.9	75.4	76.5	77.1	76.5	76.5
6	60.0	65.7	69.7	73.7	75.9	77.6	77.6	77.1	76.5	75.9	75.9	76.5	76.5	76.5
6	53.9	61.4	67.8	72.4	75.9	77.1	77.7	76.5	76.5	75.9	76.5	76.5	76.5	76.5
7	60.5	66.2	70.8	74.2	76.5	77.6	77.6	77.1	77.1	76.5	76.5	77.1	77.1	76.5
3	54.1	62.1	67.9	73.1	75.4	77.1	78.2	77.1	76.5	76.5	76.5	77.1	76.5	76.5
5	60.8	66.4	70.9	73.7	76.5	77.1	77.6	77.1	76.5	75.9	76.5	77.1	77.1	76.5
9	54.5	62.4	68.0	73.1	75.9	77.6	78.2	77.1	77.1	75.9	77.1	77.1	77.1	76.5
7	54.1	61.8	68.3	72.4	75.3	76.5	77.1	76.5	75.9	75.9	76.5	76.5	76.5	76.5
2	55.8	63.3	69.0	73.6	75.9	77.6	78.2	77.6	76.5	75.9	76.5	77.1	77.1	76.5
2	57.7	64.0	69.1	73.1	75.9	77.6	77.6	77.1	76.5	75.9	76.5	77.1	77.1	76.5
1	59.0	65.2	69.7	73.7	75.9	77.6	77.6	77.1	75.9	75.9	76.5	76.5	77.1	76.5
9	61.2	66.3	70.8	73.7	76.5	78.2	77.6	77.1	75.9	75.9	76.5	77.1	77.1	76.5
9	61.7	66.2	71.4	74.8	77.1	78.2	78.2	77.1	76.5	76.5	76.5	77.6	77.1	76.5

(Sheet 5 of 7)

Table 1 (Continued)

No.	Elev	T=0	T=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150	T=1
119A	-28.0	7.0	6.4	8.8	13.7	25.3	35.0	41.8	45.4	47.8	51.5	55
120	-23.5	7.0	10.5	15.2	24.1	36.4	42.9	48.2	49.4	52.4	55.3	58
121	-23.5	7.0	8.1	10.4	16.2	24.2	31.7	36.3	40.3	42.6	47.2	51
122	-22.8	7.0	8.1	9.8	13.8	20.1	26.4	29.8	33.8	36.6	41.8	47
123	-22.8	7.0	8.7	9.9	12.7	16.2	20.2	23.7	27.7	30.5	36.9	42
124	-28.0	7.0	7.6	9.8	13.2	18.2	23.8	27.7	31.1	34.5	40.1	45
124A	-28.0	7.0	8.2	9.9	12.8	17.4	22.1	26.7	29.6	33.6	39.4	45
125	-28.0	7.0	7.6	8.8	12.8	19.8	26.9	31.5	35.0	38.0	43.8	48
126	-28.0	7.0	7.6	8.7	12.7	20.2	27.7	33.4	37.4	40.3	45.5	50
127	-28.0	7.0	7.6	9.9	15.0	23.7	32.3	38.0	42.0	44.9	49.5	53
128	-28.0	7.0	7.6	10.4	15.6	25.4	35.1	40.9	45.5	47.2	51.8	55
129	-28.0	7.0	7.6	9.9	16.2	26.5	36.3	42.6	46.1	48.4	52.4	55
129A	-28.0	7.0	7.0	9.9	15.7	26.1	36.5	41.8	45.8	47.5	52.2	55
130	-22.8	7.0	8.2	9.9	12.2	16.3	19.2	23.2	26.1	29.6	36.0	41
131	-22.8	7.0	7.6	9.9	14.5	20.3	25.5	29.6	32.5	35.4	41.2	45
132	-22.8	7.0	8.7	12.1	18.9	29.0	37.5	41.5	44.3	46.6	50.5	54
133	-22.8	7.0	8.2	10.5	12.2	16.8	20.9	23.8	27.3	30.2	37.1	42
134	-48.0	7.0	10.4	13.3	16.1	20.1	24.1	25.8	29.2	32.6	38.3	44
135	-48.0	7.0	8.7	9.9	12.7	15.6	18.5	20.8	24.8	28.8	35.1	40
136	-48.0	7.0	10.4	14.9	21.7	33.0	42.6	47.1	49.9	51.1	54.5	57
137	-36.0	7.0	11.6	16.3	23.8	36.0	44.1	47.5	49.3	51.6	55.1	59
138	-36.0	7.0	11.6	15.6	24.2	35.7	44.3	47.8	50.7	52.4	55.8	58
139	-48.0	7.0	12.1	16.6	25.1	37.5	46.0	49.9	51.6	53.3	56.7	60
140	-47.0	7.0	11.6	16.2	25.4	37.8	48.3	52.9	55.5	57.5	63.4	64
141	-51.0	7.0	11.1	15.8	23.4	36.2	45.0	48.5	50.8	52.6	55.5	58
142	-45.0	7.0	11.0	16.0	24.0	35.8	44.9	48.8	51.1	52.8	56.2	59

T=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150	T=180	T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=66
6.4	8.8	13.7	25.3	35.0	41.8	45.4	47.8	51.5	55.2	61.3	67.4	71.0	74.7	76.5	77.7	77.7	77.1
10.5	15.2	24.1	36.4	42.9	48.2	49.4	52.4	55.3	58.2	64.7	68.3	71.3	73.6	75.9	77.1	77.1	77.1
8.1	10.4	16.2	24.2	31.7	36.3	40.3	42.6	47.2	51.8	59.3	65.0	69.6	73.6	75.9	77.6	77.6	77.1
8.1	9.8	13.8	20.1	26.4	29.8	33.8	36.6	41.8	47.4	56.0	63.4	68.5	72.5	75.9	77.1	77.6	76.5
8.7	9.9	12.7	16.2	20.2	23.7	27.7	30.5	36.9	42.6	58.0	61.6	67.9	72.5	75.9	77.6	78.2	77.1
7.6	9.8	13.2	18.2	23.8	27.7	31.1	34.5	40.1	45.1	54.6	62.5	68.1	72.6	75.4	77.6	77.6	77.1
8.2	9.9	12.8	17.4	22.1	26.7	29.6	33.6	39.4	45.2	54.5	62.6	69.0	73.0	75.9	78.2	78.2	77.7
7.6	8.8	12.8	19.8	26.9	31.5	35.0	38.0	43.8	48.5	56.6	63.7	68.9	73.0	76.5	77.7	77.7	77.1
7.6	8.7	12.7	20.2	27.7	33.4	37.4	40.3	45.5	50.1	57.5	64.4	69.6	73.6	75.9	77.6	77.6	77.1
7.6	9.9	15.0	23.7	32.3	38.0	42.0	44.9	49.5	53.5	60.4	65.6	70.2	74.2	76.5	77.6	78.2	77.1
7.6	10.4	15.6	25.4	35.1	40.9	45.5	47.2	51.8	55.2	61.6	66.7	71.3	74.8	76.5	77.6	78.2	77.6
7.6	9.9	16.2	26.5	36.3	42.6	46.1	48.4	52.4	55.8	62.1	67.3	71.3	74.8	77.1	78.2	78.2	77.6
7.0	9.9	15.7	26.1	36.5	41.8	45.8	47.5	52.2	55.7	62.0	67.2	71.3	74.2	77.1	77.7	77.7	77.1
8.2	9.9	12.2	16.3	19.2	23.2	26.1	29.6	36.0	41.8	51.6	59.7	66.1	70.7	75.3	77.1	77.7	76.5
7.6	9.9	14.5	20.3	25.5	29.6	32.5	35.4	41.2	45.8	55.1	62.0	68.4	73.0	75.9	77.1	77.1	76.5
8.7	12.1	18.9	29.0	37.5	41.5	44.3	46.6	50.5	54.5	60.7	66.3	70.8	74.2	76.5	77.1	77.6	76.5
8.2	10.5	12.2	16.8	20.9	23.8	27.3	30.2	37.1	42.9	52.8	61.4	67.8	72.4	75.9	77.7	78.2	77.1
10.4	13.3	16.1	20.1	24.1	25.8	29.2	32.6	38.3	44.6	53.7	61.7	68.0	72.5	75.4	77.1	77.1	77.1
8.7	9.9	12.7	15.6	18.5	20.8	24.8	28.8	35.1	40.9	51.8	61.0	67.3	72.5	75.9	77.1	77.6	77.1
10.4	14.9	21.7	33.0	42.6	47.1	49.9	51.1	54.5	57.3	63.5	67.5	71.4	73.7	75.9	76.5	76.5	76.5
11.6	16.3	23.8	36.0	44.1	47.5	49.3	51.6	55.1	59.1	64.9	68.4	71.9	74.8	75.9	77.1	77.1	77.1
11.6	15.6	24.2	35.7	44.3	47.8	50.7	52.4	55.8	58.7	63.9	67.9	71.9	74.2	75.9	76.5	77.1	76.5
12.1	16.6	25.1	37.5	46.0	49.9	51.6	53.3	56.7	60.1	64.6	69.2	72.0	74.8	75.9	77.1	77.1	77.1
11.6	16.2	25.4	37.8	48.3	52.9	55.5	57.5	63.4	64.0	64.0	64.7	66.7	69.9	75.8	77.2	77.2	77.2
11.1	15.8	23.4	36.2	45.0	48.5	50.8	52.6	55.5	58.4	63.1	67.2	70.7	74.2	75.9	77.1	77.1	76.5
11.0	16.0	24.0	35.8	44.9	48.8	51.1	52.8	56.2	59.0	64.1	68.6	72.0	74.8	75.9	77.1	77.1	76.5

180	T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=660	T=720	T=780	T=840	T=900	T=1020	T=1200
5.2	61.3	67.4	71.0	74.7	76.5	77.7	77.7	77.1	75.9	75.9	76.5	77.1	77.1	76.5
8.2	64.7	68.3	71.3	73.6	75.9	77.1	77.1	77.1	76.5	75.9	75.9	77.1	76.5	76.5
1.8	59.3	65.0	69.6	73.6	75.9	77.6	77.6	77.1	76.5	75.9	76.5	76.5	77.1	76.5
7.4	56.0	63.4	68.5	72.5	75.9	77.1	77.6	76.5	76.5	75.9	76.5	76.5	76.5	76.5
2.6	58.0	61.6	67.9	72.5	75.9	77.6	78.2	77.1	76.5	76.5	76.5	76.5	77.1	76.5
5.1	54.6	62.5	68.1	72.6	75.4	77.6	77.6	77.1	76.5	75.9	76.5	76.5	77.1	76.5
5.2	54.5	62.6	69.0	73.0	75.9	78.2	78.2	77.7	77.1	76.5	77.1	77.7	77.7	76.5
8.5	56.6	63.7	68.9	73.0	76.5	77.7	77.7	77.1	76.5	76.5	76.5	77.1	77.1	76.5
0.1	57.5	64.4	69.6	73.6	75.9	77.6	77.6	77.1	76.5	75.9	76.5	77.1	77.1	76.5
3.5	60.4	65.6	70.2	74.2	76.5	77.6	78.2	77.1	76.5	75.9	76.5	77.1	77.1	76.5
5.2	61.6	66.7	71.3	74.8	76.5	77.6	78.2	77.6	76.5	76.5	76.5	77.1	77.1	76.5
5.8	62.1	67.3	71.3	74.8	77.1	78.2	78.2	77.6	76.5	76.5	77.1	77.1	77.1	76.5
5.7	62.0	67.2	71.3	74.2	77.1	77.7	77.7	77.1	76.5	75.9	76.5	77.1	77.1	76.5
1.8	51.6	59.7	66.1	70.7	75.3	77.1	77.7	76.5	76.5	75.9	76.5	76.5	77.1	76.5
5.8	55.1	62.0	68.4	73.0	75.9	77.1	77.1	76.5	76.5	75.3	76.5	76.5	76.5	76.5
4.5	60.7	66.3	70.8	74.2	76.5	77.1	77.6	76.5	75.9	76.5	76.5	77.1	77.1	76.5
2.9	52.8	61.4	67.8	72.4	75.9	77.7	78.2	77.1	75.9	75.9	76.5	76.5	77.1	76.5
4.6	53.7	61.7	68.0	72.5	75.4	77.1	77.1	77.1	75.9	75.9	76.5	76.5	76.5	76.5
0.9	51.8	61.0	67.3	72.5	75.9	77.1	77.6	77.1	76.5	76.5	76.5	77.1	77.1	76.5
7.3	63.5	67.5	71.4	73.7	75.9	76.5	76.5	76.5	75.9	75.9	76.5	76.5	77.1	76.5
9.1	64.9	68.4	71.9	74.8	75.9	77.1	77.1	77.1	76.5	75.9	76.5	76.5	76.5	76.5
8.7	63.9	67.9	71.9	74.2	75.9	76.5	77.1	76.5	75.9	75.9	75.9	76.5	76.5	76.5
0.1	64.6	69.2	72.0	74.8	75.9	77.1	77.1	77.1	76.5	75.9	76.5	76.5	77.1	76.5
4.0	64.0	64.7	66.7	69.9	75.8	77.2	77.2	77.2	76.5	76.5	76.5	77.2	77.2	76.5
8.4	63.1	67.2	70.7	74.2	75.9	77.1	77.1	76.5	75.9	75.9	75.9	76.5	76.5	76.5
9.0	64.1	68.6	72.0	74.8	75.9	77.1	77.1	76.5	76.5	75.9	76.5	77.1	77.1	76.5

(Sheet 6 of 7)

Table 1 (Concluded)

No.	Elev	T=0	T=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150
143	-49.0	7.0	11.8	16.7	25.1	36.6	43.9	47.5	49.3	51.7	54.7
144	-31.0	7.0	11.1	16.3	23.9	36.2	43.8	47.3	49.6	51.4	54.9
144A	-31.0	7.0	11.1	15.8	23.5	34.7	42.9	47.1	50.0	52.9	56.5
145	-51.4	7.0	11.0	15.5	24.1	35.5	45.2	48.0	50.3	52.0	55.4
146	-49.0	7.0	11.6	15.5	23.5	35.5	44.6	48.0	50.9	52.0	55.4
147	-46.6	7.0	11.0	16.2	26.0	38.0	45.5	49.5	52.4	54.1	57.0
148	-45.0	7.0	11.6	16.2	25.4	38.0	46.1	49.5	51.8	54.1	57.0
149	-45.0	7.0	11.6	15.7	24.4	36.5	44.6	49.3	51.6	53.3	56.2
149A	-45.0	7.0	10.7	15.1	24.4	36.8	45.5	49.2	52.3	53.5	56.6
150	-45.0	7.0	11.0	15.5	23.4	35.8	46.0	48.8	51.6	52.8	55.6
151	-38.0	7.0	10.6	14.9	23.3	37.2	46.9	49.9	51.7	53.5	56.0
152	-38.0	7.0	11.1	15.8	23.9	36.8	46.1	49.6	52.0	53.7	56.6
153	-38.0	7.0	12.1	16.0	24.0	35.8	44.9	48.8	51.6	53.3	56.7
154	-38.0	7.0	11.2	15.4	23.8	37.0	45.9	49.5	51.9	53.7	56.7
155	-38.0	7.0	11.6	15.1	23.8	36.5	45.2	48.7	51.0	52.8	55.7
156	-38.0	7.0	11.6	15.6	24.2	36.9	45.5	49.5	51.8	53.5	56.4
157	-31.0	7.0	13.3	17.3	27.1	40.9	48.4	50.1	53.0	53.5	57.0
158	-31.0	7.0	12.2	16.2	26.0	39.2	47.8	50.1	52.4	53.5	57.0

)

T=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150	T=180	T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=66
1.8	16.7	25.1	36.6	43.9	47.5	49.3	51.7	54.7	58.4	63.2	68.0	71.7	74.1	75.9	76.5	77.7	77.1
1.1	16.3	23.9	36.2	43.8	47.3	49.6	51.4	54.9	57.8	63.1	67.2	71.2	73.6	75.3	76.5	76.5	76.5
1.1	15.8	23.5	34.7	42.9	47.1	50.0	52.9	56.5	59.4	64.7	68.8	71.8	74.7	76.5	77.7	77.7	77.1
11.0	15.5	24.1	35.5	45.2	48.0	50.3	52.0	55.4	58.3	64.0	69.1	72.5	74.8	76.5	77.6	77.6	77.1
1.6	15.5	23.5	35.5	44.6	48.0	50.9	52.0	55.4	58.3	64.0	67.4	71.9	74.2	76.5	76.5	77.1	76.5
11.0	16.2	26.0	38.0	45.5	49.5	52.4	54.1	57.0	59.8	65.0	69.0	73.1	75.4	77.1	77.6	78.2	77.1
11.6	16.2	25.4	38.0	46.1	49.5	51.8	54.1	57.0	59.3	64.4	68.5	72.5	74.8	76.5	77.1	77.6	76.5
11.6	15.7	24.4	36.5	44.6	49.3	51.6	53.3	56.2	59.1	64.3	68.4	71.9	74.2	75.9	76.5	77.1	76.5
10.7	15.1	24.4	36.8	45.5	49.2	52.3	53.5	56.6	59.7	64.7	69.1	72.2	74.6	77.1	77.7	78.4	77.7
11.0	15.5	23.4	35.8	46.0	48.8	51.6	52.8	55.6	59.0	64.1	68.0	71.4	74.2	75.9	77.1	76.5	76.5
10.6	14.9	23.3	37.2	46.9	49.9	51.7	53.5	56.0	59.0	64.4	68.6	72.3	74.7	76.5	76.5	77.1	77.1
11.1	15.8	23.9	36.8	46.1	49.6	52.0	53.7	56.6	59.0	64.8	68.9	72.4	74.7	75.9	77.1	77.1	76.5
12.1	16.0	24.0	35.8	44.9	48.8	51.6	53.3	56.7	59.5	64.6	68.6	72.0	74.8	75.9	77.1	77.1	76.5
11.2	15.4	23.8	37.0	45.9	49.5	51.9	53.7	56.7	59.1	64.5	68.7	72.3	74.7	76.5	77.1	77.7	77.1
11.6	15.1	23.8	36.5	45.2	48.7	51.0	52.8	55.7	58.5	63.8	67.8	70.7	73.6	75.3	75.9	77.1	76.5
11.6	15.6	24.2	36.9	45.5	49.5	51.8	53.5	56.4	59.3	64.4	69.0	71.9	74.8	75.9	77.1	77.1	76.5
13.3	17.3	27.1	40.9	48.4	50.1	53.0	53.5	57.0	60.4	65.6	69.0	72.5	75.4	77.1	77.1	77.6	77.6
12.2	16.2	26.0	39.2	47.8	50.1	52.4	53.5	57.0	59.8	65.6	68.5	72.5	74.8	76.5	77.6	78.2	77.1

80	T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=660	T=720	T=780	T=840	T=900	T=1020	T=1200
.4	63.2	68.0	71.7	74.1	75.9	76.5	77.7	77.1	77.1	76.5	76.5	77.1	77.1	76.5
.8	63.1	67.2	71.2	73.6	75.3	76.5	76.5	76.5	75.3	75.9	75.3	75.9	76.5	76.5
.4	64.7	68.8	71.8	74.7	76.5	77.7	77.7	77.1	76.5	76.5	76.5	77.1	77.1	76.5
.3	64.0	69.1	72.5	74.8	76.5	77.6	77.6	77.1	76.5	75.9	76.5	76.5	77.1	76.5
.3	64.0	67.4	71.9	74.2	76.5	76.5	77.1	76.5	75.9	75.9	76.5	76.5	76.5	76.5
.8	65.0	69.0	73.1	75.4	77.1	77.6	78.2	77.1	76.5	76.5	77.1	77.1	77.1	76.5
.3	64.4	68.5	72.5	74.8	76.5	77.1	77.6	76.5	75.9	76.5	76.5	77.1	77.1	76.5
.1	64.3	68.4	71.9	74.2	75.9	76.5	77.1	76.5	75.9	75.9	75.9	76.5	76.5	76.5
.7	64.7	69.1	72.2	74.6	77.1	77.7	78.4	77.7	76.5	76.5	76.5	77.1	77.1	76.5
.0	64.1	68.0	71.4	74.2	75.9	77.1	76.5	76.5	75.9	75.9	75.9	75.4	76.5	76.5
.0	64.4	68.6	72.3	74.7	76.5	76.5	77.1	77.1	76.5	75.9	76.5	76.5	76.5	76.5
.0	64.8	68.9	72.4	74.7	75.9	77.1	77.1	76.5	75.9	75.9	75.9	76.5	76.5	76.5
.5	64.6	68.6	72.0	74.8	75.9	77.1	77.1	76.5	75.9	75.9	75.9	76.5	76.5	76.5
.1	64.5	68.7	72.3	74.7	76.5	77.1	77.7	77.1	75.9	76.5	76.5	77.1	77.1	76.5
.5	63.8	67.8	70.7	73.6	75.3	75.9	77.1	76.5	75.9	75.9	75.9	76.5	76.5	76.5
.3	64.4	69.0	71.9	74.8	75.9	77.1	77.1	76.5	75.9	75.9	76.5	76.5	75.9	76.5
.4	65.6	69.0	72.5	75.4	77.1	77.1	77.6	77.6	77.1	76.5	77.1	77.1	77.1	76.5
.8	65.6	68.5	72.5	74.8	76.5	77.6	78.2	77.1	76.5	76.5	77.1	77.1	77.6	76.5

(Sheet 7 of 7)

Table 2
H-H Pattern System, Average Piezometer Reading During Emptying Operatior
Normal Valve Operation

No.	Elev	T=0	T=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150
UP	—	76.5	76.5	76.5	76.5	76.5	76.5	77.1	76.5	76.5	76.5
LC	—	76.5	75.9	75.4	74.2	72.0	69.7	66.9	64.1	62.4	56.7
LP	—	7.0	7.0	7.0	6.4	7.6	7.0	7.0	7.0	7.0	7.0
14	-53.0	76.5	73.1	68.5	60.0	53.1	48.0	45.2	43.5	42.9	39.5
15	-46.0	76.5	72.5	68.6	61.2	53.3	48.8	45.4	43.2	43.7	39.2
16	-3.0	76.5	75.9	75.9	76.5	75.9	76.5	76.5	76.5	76.5	75.9
17	-3.0	76.5	72.9	68.1	60.8	52.4	47.9	45.1	44.0	42.9	38.9
18	-39.0	76.5	73.1	68.5	61.1	53.1	48.0	45.2	42.9	42.9	38.9
19	-38.4	76.5	73.1	69.2	61.2	53.9	48.8	46.0	43.7	43.2	39.8
20	-37.7	76.5	74.0	69.6	61.3	53.8	51.9	51.2	51.2	51.2	51.2
21	-37.7	76.5	73.7	69.1	61.1	53.7	48.6	46.3	44.0	42.3	39.5
22	-37.0	76.5	72.4	68.4	61.4	52.8	47.5	45.8	43.5	41.8	38.9
23	-36.0	76.5	72.6	68.1	60.8	53.0	47.9	45.7	44.0	41.8	38.4
24	-35.0	76.5	72.0	67.5	60.2	52.4	47.4	45.7	44.0	41.2	38.4
25	-33.5	76.5	72.5	67.9	60.4	52.4	47.2	45.5	43.8	41.5	38.6
26	-32.0	76.5	72.0	68.0	60.7	52.8	47.7	46.0	43.7	41.5	38.1
27	-31.0	76.5	73.1	68.5	60.5	52.0	47.4	45.7	43.5	41.2	38.9
27A	-31.0	76.5	72.0	67.5	60.1	51.6	48.2	46.0	44.3	43.2	40.3
28	-42.0	76.5	73.0	69.0	60.9	53.3	48.7	46.4	44.1	42.9	40.0
29	-42.0	76.5	73.1	68.5	61.1	52.6	48.0	45.7	43.5	42.3	38.9
30	-42.0	76.5	72.0	68.0	60.7	52.2	48.2	45.4	43.2	42.6	39.2
31	-42.0	76.5	71.9	68.4	60.9	52.2	48.1	44.6	43.5	42.3	38.9
32	-53.0	76.5	73.1	68.6	61.2	53.3	48.2	45.4	43.7	43.2	39.2
33	-53.0	76.5	73.6	68.5	61.0	53.0	48.4	45.5	43.8	42.6	39.2
34	-53.0	76.5	71.5	68.1	60.2	52.4	47.9	45.1	44.0	42.3	38.9

n, Average Piezometer Reading During Emptying Operation, Type 2 System, Lift 69.5 ft, Valve Speed 1 Min, Upper Po
ration

T=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150	T=180	T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=6
76.5	76.5	76.5	76.5	76.5	77.1	76.5	76.5	76.5	76.5	76.5	77.1	76.5	77.1	76.5	76.5	76.5	76
75.9	75.4	74.2	72.0	69.7	66.9	64.1	62.4	56.7	52.8	44.3	36.4	30.2	24.5	19.4	15.5	12.1	9
7.0	7.0	6.4	7.6	7.0	7.0	7.0	7.0	7.0	7.0	6.4	7.0	7.0	7.0	7.0	7.0	6.4	7
73.1	68.5	60.0	53.1	48.0	45.2	43.5	42.9	39.5	36.1	31.5	26.4	23.0	18.4	15.5	13.3	11.0	9
72.5	68.6	61.2	53.3	48.8	45.4	43.2	43.7	39.2	36.4	31.3	26.2	22.3	18.3	14.3	12.1	9.8	8
75.9	75.9	76.5	75.9	76.5	76.5	76.5	76.5	75.9	76.5	76.5	75.9	75.9	75.9	76.5	75.9	75.9	75
72.9	68.1	60.8	52.4	47.9	45.1	44.0	42.9	38.9	36.1	31.1	26.1	22.1	18.2	14.8	12.6	10.9	8
73.1	68.5	61.1	53.1	48.0	45.2	42.9	42.9	38.9	36.1	30.9	26.4	22.4	18.4	15.0	12.1	9.8	8
73.1	69.2	61.2	53.9	48.8	46.0	43.7	43.2	39.8	36.4	30.7	26.2	22.3	18.3	14.9	12.7	9.8	8
74.0	69.6	61.3	53.8	51.9	51.2	51.2	51.2	51.2	40.5	33.5	27.9	23.4	19.0	15.8	12.1	10.2	8
73.7	69.1	61.1	53.7	48.6	46.3	44.0	42.3	39.5	36.6	30.9	26.4	22.4	17.8	15.0	12.1	10.4	8
72.4	68.4	61.4	52.8	47.5	45.8	43.5	41.8	38.9	36.5	30.7	26.1	22.1	18.0	14.5	12.8	10.5	8
72.6	68.1	60.8	53.0	47.9	45.7	44.0	41.8	38.4	36.1	30.5	26.1	22.1	18.2	14.8	12.6	10.4	8
72.0	67.5	60.2	52.4	47.4	45.7	44.0	41.2	38.4	36.1	30.5	26.1	21.6	17.6	14.8	12.0	9.8	8
72.5	67.9	60.4	52.4	47.2	45.5	43.8	41.5	38.6	36.3	30.5	26.0	21.4	17.9	14.5	11.6	9.9	8
72.0	68.0	60.7	52.8	47.7	46.0	43.7	41.5	38.1	36.4	30.7	25.6	21.7	17.7	14.9	12.1	9.8	8
73.1	68.5	60.5	52.0	47.4	45.7	43.5	41.2	38.9	36.1	30.4	25.8	21.8	17.8	15.0	12.1	10.4	8
72.0	67.5	60.1	51.6	48.2	46.0	44.3	43.2	40.3	36.4	31.3	26.8	22.3	18.3	14.3	12.1	9.8	8
73.0	69.0	60.9	53.3	48.7	46.4	44.1	42.9	40.0	37.1	31.3	26.1	22.1	18.6	15.1	12.2	10.5	8
73.1	68.5	61.1	52.6	48.0	45.7	43.5	42.3	38.9	36.6	30.9	26.4	21.8	18.4	15.0	11.6	9.8	8
72.0	68.0	60.7	52.2	48.2	45.4	43.2	42.6	39.2	36.4	30.7	26.2	21.7	18.3	14.9	12.1	10.4	8
71.9	68.4	60.9	52.2	48.1	44.6	43.5	42.3	38.9	36.0	30.7	26.1	21.5	18.6	14.5	12.2	10.5	8
73.1	68.6	61.2	53.3	48.2	45.4	43.7	43.2	39.2	36.4	31.3	26.8	21.7	18.3	15.5	12.7	9.8	8
73.6	68.5	61.0	53.0	48.4	45.5	43.8	42.6	39.2	36.9	31.1	27.1	22.5	19.1	15.6	12.7	11.6	9
71.5	68.1	60.2	52.4	47.9	45.1	44.0	42.3	38.9	36.1	31.1	26.1	21.6	18.2	15.4	12.6	10.4	9

, Type 2 System, Lift 69.5 ft, Valve Speed 1 Min, Upper Pool El 76.5, Lower Pool El 7,

=180	T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=660	T=720	T=780	T=840	T=900	T=1020	T=1380
76.5	76.5	77.1	76.5	77.1	76.5	76.5	76.5	76.5	76.5	77.1	76.5	76.5	76.5	76.5
52.8	44.3	36.4	30.2	24.5	19.4	15.5	12.1	9.8	7.6	7.0	7.0	7.0	7.6	7.0
7.0	6.4	7.0	7.0	7.0	7.0	7.0	6.4	7.0	7.0	6.4	6.4	7.0	6.4	6.4
36.1	31.5	26.4	23.0	18.4	15.5	13.3	11.0	9.3	8.1	7.6	7.0	7.0	7.6	7.0
36.4	31.3	26.2	22.3	18.3	14.3	12.1	9.8	8.7	7.6	7.0	6.4	7.0	7.0	7.0
76.5	76.5	75.9	75.9	75.9	76.5	75.9	75.9	75.9	75.9	76.5	75.9	75.9	75.9	76.5
36.1	31.1	26.1	22.1	18.2	14.8	12.6	10.9	8.7	7.0	7.0	6.4	7.0	7.6	7.0
36.1	30.9	26.4	22.4	18.4	15.0	12.1	9.8	8.1	7.6	6.4	6.4	6.4	7.0	7.0
36.4	30.7	26.2	22.3	18.3	14.9	12.7	9.8	8.7	7.6	7.0	6.4	7.0	7.6	7.0
40.5	33.5	27.9	23.4	19.0	15.8	12.1	10.2	8.3	8.3	7.6	7.6	7.0	7.0	7.0
36.6	30.9	26.4	22.4	17.8	15.0	12.1	10.4	8.7	7.6	7.0	6.4	7.0	7.6	7.0
36.5	30.7	26.1	22.1	18.0	14.5	12.8	10.5	8.7	7.6	7.0	7.0	7.0	7.0	7.0
36.1	30.5	26.1	22.1	18.2	14.8	12.6	10.4	8.7	7.6	7.0	6.4	7.0	7.6	7.0
36.1	30.5	26.1	21.6	17.6	14.8	12.0	9.8	8.7	7.6	6.4	6.4	7.0	7.0	7.0
36.3	30.5	26.0	21.4	17.9	14.5	11.6	9.9	8.1	7.0	6.4	5.9	6.4	7.0	7.0
36.4	30.7	25.6	21.7	17.7	14.9	12.1	9.8	8.1	7.6	6.4	6.4	7.0	7.0	7.0
36.1	30.4	25.8	21.8	17.8	15.0	12.1	10.4	8.7	7.6	7.0	6.4	7.0	7.0	7.0
36.4	31.3	26.8	22.3	18.3	14.3	12.1	9.8	8.1	7.0	6.4	6.4	7.0	7.6	7.0
37.1	31.3	26.1	22.1	18.6	15.1	12.2	10.5	8.7	7.0	6.4	7.0	7.0	7.6	7.0
36.6	30.9	26.4	21.8	18.4	15.0	11.6	9.8	8.1	7.0	7.0	6.4	6.4	7.0	7.0
36.4	30.7	26.2	21.7	18.3	14.9	12.1	10.4	8.7	7.6	7.0	7.0	7.0	7.6	7.0
36.0	30.7	26.1	21.5	18.6	14.5	12.2	10.5	8.7	7.6	7.0	6.4	7.0	7.6	7.0
36.4	31.3	26.8	21.7	18.3	15.5	12.7	9.8	8.7	7.6	7.0	6.4	6.4	7.6	7.0
36.9	31.1	27.1	22.5	19.1	15.6	12.7	11.6	9.9	8.7	8.1	8.1	7.6	7.0	7.0
36.1	31.1	26.1	21.6	18.2	15.4	12.6	10.4	9.2	7.6	7.0	7.0	7.0	7.6	7.0

(Sheet 1 of 8)

Table 2 (Continued)

No.	Elev	T=0	T=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150	T=
35	-53.0	76.5	72.0	68.0	59.5	51.6	47.7	44.3	43.7	41.5	38.6	3
36	-53.0	76.5	72.4	68.8	63.0	55.3	51.2	48.2	45.9	44.1	40.6	3
36A	-53.0	76.5	72.5	68.5	60.4	53.0	48.4	45.5	44.3	42.0	39.7	3
37	-48.0	76.5	72.5	68.5	61.0	53.0	48.9	45.5	44.3	42.0	39.2	3
38	-36.0	76.5	72.0	68.1	59.7	51.8	46.8	43.4	42.9	40.6	37.8	3
39	-48.0	76.5	72.4	69.0	60.3	51.6	48.1	44.6	43.5	41.2	39.4	3
40	-36.0	76.5	72.5	68.5	59.8	51.2	46.1	43.8	42.6	40.3	37.4	3
41	-36.0	76.5	71.4	67.5	59.5	51.1	45.4	43.2	40.9	39.8	37.5	3
42	-36.0	76.5	73.1	67.9	59.3	51.2	44.9	41.5	39.7	38.6	35.7	3
43	-33.0	76.5	71.1	66.2	54.7	43.9	37.8	31.8	30.6	30.0	27.5	2
44	-37.0	76.5	71.9	66.2	54.9	43.5	37.8	32.1	30.4	29.8	28.1	2
45	-39.0	76.5	71.9	67.9	59.8	51.2	44.9	42.0	40.9	39.2	35.7	3
46	-35.0	76.5	71.9	66.8	59.4	51.4	46.9	40.6	40.6	37.8	37.2	3
47	-36.0	76.5	72.0	67.5	59.7	51.8	46.8	44.0	41.8	40.6	37.8	3
48	-36.0	76.5	73.1	68.6	62.9	56.2	52.2	49.4	47.7	46.0	42.6	3
49	-36.0	76.5	71.9	68.5	62.8	56.6	52.6	49.7	47.4	46.3	42.9	3
50	-31.0	76.5	72.0	68.7	60.8	53.5	49.0	46.8	44.6	43.4	40.6	3
51	-42.0	76.5	73.0	69.6	62.6	55.7	52.2	49.3	47.0	45.8	42.3	3
52	-27.8	76.5	73.0	68.9	61.3	53.7	50.2	47.3	46.1	43.8	40.9	3
53	-49.5	76.5	72.0	68.6	62.4	55.6	52.2	49.4	47.7	46.6	42.6	3
54	-21.6	76.5	73.1	69.6	63.3	57.0	53.5	50.1	48.4	45.5	42.0	3
55	-41.6	76.5	72.4	68.9	61.3	54.9	50.8	48.5	46.7	45.0	42.0	3
56	-17.5	76.5	72.6	68.8	61.1	54.0	49.5	46.3	45.0	43.0	39.2	3
57	-35.2	76.5	72.0	67.5	60.1	52.8	49.4	46.6	45.4	43.2	39.8	3
58	-31.3	76.5	73.6	69.0	62.6	55.7	51.6	48.7	47.0	45.8	42.3	3
59	-31.3	76.5	74.2	69.6	63.3	55.8	51.8	48.4	47.2	45.5	42.0	3

=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150	T=180	T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=660
2.0	68.0	59.5	51.6	47.7	44.3	43.7	41.5	38.6	36.4	30.7	25.6	21.7	17.7	14.3	12.1	9.8	8.1
2.4	68.8	63.0	55.3	51.2	48.2	45.9	44.1	40.6	37.6	32.3	27.0	22.3	19.4	15.8	12.9	10.5	8.8
2.5	68.5	60.4	53.0	48.4	45.5	44.3	42.0	39.7	36.9	31.1	26.0	21.4	17.9	14.5	12.2	9.9	8.1
2.5	68.5	61.0	53.0	48.9	45.5	44.3	42.0	39.2	35.7	31.1	26.0	21.4	17.9	14.5	12.2	9.9	8.1
2.0	68.1	59.7	51.8	46.8	43.4	42.9	40.6	37.8	35.6	30.0	24.9	21.6	17.6	14.8	12.0	9.8	8.7
2.4	69.0	60.3	51.6	48.1	44.6	43.5	41.2	39.4	36.0	30.7	26.1	22.1	18.0	15.1	12.2	11.1	8.7
2.5	68.5	59.8	51.2	46.1	43.8	42.6	40.3	37.4	35.1	30.0	25.4	21.4	17.9	14.5	12.2	9.9	8.1
1.4	67.5	59.5	51.1	45.4	43.2	40.9	39.8	37.5	35.3	30.2	25.1	21.1	17.7	14.3	12.1	9.8	8.7
3.1	67.9	59.3	51.2	44.9	41.5	39.7	38.6	35.7	32.8	28.3	24.2	20.8	17.3	14.5	11.6	9.9	8.7
1.1	66.2	54.7	43.9	37.8	31.8	30.6	30.0	27.5	25.7	23.3	19.1	17.3	14.3	13.0	11.2	9.4	8.2
1.9	66.2	54.9	43.5	37.8	32.1	30.4	29.8	28.1	25.8	23.0	19.5	17.3	15.0	12.1	9.8	9.3	8.1
1.9	67.9	59.8	51.2	44.9	42.0	40.9	39.2	35.7	32.8	28.3	24.2	19.6	16.8	13.9	11.6	9.9	8.1
1.9	66.8	59.4	51.4	46.9	40.6	40.6	37.8	37.2	33.8	29.2	24.1	20.7	17.8	14.4	11.6	9.8	8.1
2.0	67.5	59.7	51.8	46.8	44.0	41.8	40.6	37.8	35.0	29.4	24.9	21.0	17.6	14.3	12.0	9.8	8.7
3.1	68.6	62.9	56.2	52.2	49.4	47.7	46.0	42.6	39.2	33.6	27.9	24.0	19.4	16.0	13.2	11.0	9.8
1.9	68.5	62.8	56.6	52.6	49.7	47.4	46.3	42.9	39.5	33.2	28.1	23.5	19.5	16.1	12.7	10.4	8.7
2.0	68.7	60.8	53.5	49.0	46.8	44.6	43.4	40.6	37.3	31.7	26.6	22.1	18.8	15.4	12.6	10.4	8.7
3.0	69.6	62.6	55.7	52.2	49.3	47.0	45.8	42.3	39.4	33.1	27.9	22.6	19.2	15.7	12.2	9.9	8.2
3.0	68.9	61.3	53.7	50.2	47.3	46.1	43.8	40.9	37.4	32.1	26.3	22.2	18.1	14.6	11.7	9.9	8.2
2.0	68.6	62.4	55.6	52.2	49.4	47.7	46.6	42.6	39.8	33.6	27.9	23.4	19.4	15.5	12.7	10.4	8.7
3.1	69.6	63.3	57.0	53.5	50.1	48.4	45.5	42.0	39.2	33.4	27.7	23.1	19.1	15.6	12.2	10.4	8.7
2.4	68.9	61.3	54.9	50.8	48.5	46.7	45.0	42.0	38.5	32.7	27.4	22.8	18.7	15.8	12.3	9.9	8.8
2.6	68.8	61.1	54.0	49.5	46.3	45.0	43.0	39.2	35.3	29.5	23.1	18.6	14.7	13.4	12.8	11.5	11.5
2.0	67.5	60.1	52.8	49.4	46.6	45.4	43.2	39.8	36.9	31.9	26.2	22.3	18.3	15.5	12.1	9.8	8.1
3.6	69.0	62.6	55.7	51.6	48.7	47.0	45.8	42.3	38.9	33.1	27.9	22.6	19.2	15.7	12.2	10.5	8.7
4.2	69.6	63.3	55.8	51.8	48.4	47.2	45.5	42.0	38.6	32.8	27.7	22.5	18.5	15.0	12.2	9.9	8.1

180	T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=660	T=720	T=780	T=840	T=900	T=1020	T=1380
6.4	30.7	25.6	21.7	17.7	14.3	12.1	9.8	8.1	7.6	6.4	7.0	6.4	7.0	7.0
7.6	32.3	27.0	22.3	19.4	15.8	12.9	10.5	8.8	7.6	7.0	7.0	7.0	7.6	7.0
6.9	31.1	26.0	21.4	17.9	14.5	12.2	9.9	8.1	7.0	6.4	6.4	6.4	7.0	7.0
5.7	31.1	26.0	21.4	17.9	14.5	12.2	9.9	8.1	6.4	5.9	5.9	5.9	6.4	7.0
5.6	30.0	24.9	21.6	17.6	14.8	12.0	9.8	8.7	7.6	7.0	5.9	7.0	7.6	7.0
6.0	30.7	26.1	22.1	18.0	15.1	12.2	11.1	8.7	7.0	7.0	7.0	7.0	7.6	7.0
5.1	30.0	25.4	21.4	17.9	14.5	12.2	9.9	8.1	7.6	6.4	6.4	7.0	7.0	7.0
5.3	30.2	25.1	21.1	17.7	14.3	12.1	9.8	8.7	7.6	7.0	7.0	7.0	7.6	7.0
2.8	28.3	24.2	20.8	17.3	14.5	11.6	9.9	8.7	7.6	7.6	7.0	7.0	7.6	7.0
5.7	23.3	19.1	17.3	14.3	13.0	11.2	9.4	8.2	8.2	7.0	7.0	7.0	7.6	7.0
5.8	23.0	19.5	17.3	15.0	12.1	9.8	9.3	8.1	7.0	6.4	5.9	7.0	7.6	7.0
2.8	28.3	24.2	19.6	16.8	13.9	11.6	9.9	8.1	6.4	6.4	6.4	6.4	7.0	7.0
3.8	29.2	24.1	20.7	17.8	14.4	11.6	9.8	8.1	7.0	7.0	7.0	6.4	7.0	7.0
5.0	29.4	24.9	21.0	17.6	14.3	12.0	9.8	8.7	7.6	7.0	7.0	6.4	7.6	7.0
.2	33.6	27.9	24.0	19.4	16.0	13.2	11.0	9.8	7.6	7.0	6.4	7.6	7.6	7.0
.5	33.2	28.1	23.5	19.5	16.1	12.7	10.4	8.7	7.6	7.0	7.0	6.4	7.0	7.0
.3	31.7	26.6	22.1	18.8	15.4	12.6	10.4	8.7	7.6	7.0	7.0	7.0	7.6	7.0
.4	33.1	27.9	22.6	19.2	15.7	12.2	9.9	8.2	7.6	7.0	6.4	6.4	7.0	7.0
.4	32.1	26.3	22.2	18.1	14.6	11.7	9.9	8.2	7.0	6.4	5.8	6.4	7.0	7.0
.8	33.6	27.9	23.4	19.4	15.5	12.7	10.4	8.7	7.6	7.0	7.0	7.0	7.6	7.0
.2	33.4	27.7	23.1	19.1	15.6	12.2	10.4	8.7	7.6	6.4	6.4	6.4	7.0	7.0
.5	32.7	27.4	22.8	18.7	15.8	12.3	9.9	8.8	8.2	7.0	6.4	7.0	7.6	7.0
.3	29.5	23.1	18.6	14.7	13.4	12.8	11.5	11.5	11.5	10.2	10.2	9.6	8.3	7.0
.9	31.9	26.2	22.3	18.3	15.5	12.1	9.8	8.1	7.0	6.4	6.4	7.0	8.1	7.0
.9	33.1	27.9	22.6	19.2	15.7	12.2	10.5	8.7	7.0	7.0	7.0	6.4	7.6	7.0
.6	32.8	27.7	22.5	18.5	15.0	12.2	9.9	8.1	7.0	6.4	6.4	7.0	7.6	7.0

(Sheet 2 of 8)

Table 2 (Continued)

No.	Elev.	T=0	T=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150
60	-23.1	76.5	73.1	68.5	60.5	53.1	48.0	45.2	44.0	42.3	39.5
61	-23.1	76.5	74.2	70.7	64.3	58.5	55.1	52.2	50.4	48.1	44.6
62	-22.8	76.5	74.2	68.4	60.3	51.0	47.0	42.9	41.8	40.0	37.7
63	-22.8	76.5	74.2	70.8	64.5	58.3	54.9	51.4	50.3	48.6	45.2
64	-22.4	76.5	74.2	68.6	60.1	52.2	47.1	44.3	42.0	41.5	38.1
65	-22.4	76.5	77.1	77.1	76.5	61.7	57.7	54.3	51.4	50.3	46.3
66	-28.0	76.5	74.8	70.8	65.7	58.8	54.3	50.9	48.6	46.9	43.5
66A	-28.0	—	—	—	—	—	—	—	—	—	—
67	-28.0	76.5	75.3	72.9	68.1	63.3	60.3	56.7	55.5	52.5	48.9
68	-28.0	76.5	76.5	74.7	73.4	72.2	67.9	61.7	60.5	58.7	54.4
69	-28.0	76.5	75.9	74.1	69.9	66.2	63.2	60.8	58.4	56.6	52.3
70	-28.0	76.5	75.9	73.7	70.2	66.8	63.4	60.0	58.3	56.0	52.0
71	-28.0	76.5	75.9	73.1	69.1	66.2	62.3	60.5	58.3	56.0	51.4
71A	-28.0	76.5	75.9	73.7	70.3	67.0	63.0	60.2	58.6	56.3	51.3
72	-23.5	76.5	74.2	70.2	62.8	56.0	52.0	49.2	48.0	46.3	42.9
73	-23.5	76.5	73.6	67.9	58.7	50.1	44.9	42.0	40.3	38.6	36.9
74	-22.8	76.5	74.2	69.1	61.1	53.7	49.7	46.9	45.2	43.5	40.6
75	-22.8	76.5	73.7	69.1	62.3	56.0	52.0	49.2	47.4	46.3	42.3
76	-28.0	76.5	74.2	69.7	64.1	57.3	52.2	49.9	47.7	46.0	42.6
76A	-28.0	76.5	75.9	71.3	65.5	58.0	53.9	49.9	48.1	46.4	42.9
77	-28.0	76.5	76.5	73.0	67.2	61.4	57.4	54.5	52.2	49.9	47.0
78	-28.0	76.5	74.8	72.0	68.1	63.0	59.7	56.9	55.2	52.4	48.5
79	-28.0	76.5	74.8	72.5	69.1	64.5	61.1	58.8	57.1	54.9	49.7
80	-28.0	76.5	75.4	73.7	69.7	66.2	62.8	60.5	58.3	56.0	51.4
81	-28.0	76.5	75.9	73.6	70.2	67.3	63.3	61.0	58.7	56.4	51.2
81A	-28.0	76.5	75.9	73.7	69.7	66.2	63.4	60.5	58.3	56.0	52.0

ed)

T=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150	T=180	T=240	T=300	T=360	T=420	T=480	T=540	T=600
73.1	68.5	60.5	53.1	48.0	45.2	44.0	42.3	39.5	36.1	30.9	25.8	21.8	18.4	15.0	12.1	10.4
74.2	70.7	64.3	58.5	55.1	52.2	50.4	48.1	44.6	41.8	34.8	29.0	24.4	20.3	16.3	13.4	11.1
74.2	68.4	60.3	51.0	47.0	42.9	41.8	40.0	37.7	34.8	29.6	25.5	21.5	18.0	15.1	13.4	11.1
74.2	70.8	64.5	58.3	54.9	51.4	50.3	48.6	45.2	41.2	34.9	29.2	24.1	19.5	16.7	13.3	11.0
74.2	68.6	60.1	52.2	47.1	44.3	42.0	41.5	38.1	35.3	30.2	25.6	21.1	17.7	14.3	12.1	9.8
77.1	77.1	76.5	61.7	57.7	54.3	51.4	50.3	46.3	42.9	36.6	30.9	24.7	20.7	16.7	13.8	11.0
74.8	70.8	65.7	58.8	54.3	50.9	48.6	46.9	43.5	40.0	33.8	29.2	23.5	19.5	16.1	13.3	10.4
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
75.3	72.9	68.1	63.3	60.3	56.7	55.5	52.5	48.9	45.3	38.2	31.6	25.6	21.4	17.2	13.6	10.6
76.5	74.7	73.4	72.2	67.9	61.7	60.5	58.7	54.4	49.4	40.8	34.1	27.3	22.4	17.5	13.8	10.7
75.9	74.1	69.9	66.2	63.2	60.8	58.4	56.6	52.3	48.1	40.8	33.0	28.2	22.7	17.9	14.9	11.8
75.9	73.7	70.2	66.8	63.4	60.0	58.3	56.0	52.0	48.0	40.6	33.2	27.5	22.4	17.8	14.4	11.0
75.9	73.1	69.1	66.2	62.3	60.5	58.3	56.0	51.4	47.4	39.5	32.6	26.4	21.8	16.7	13.8	11.0
75.9	73.7	70.3	67.0	63.0	60.2	58.6	56.3	51.3	47.4	40.6	33.3	27.2	22.1	17.6	14.3	10.9
74.2	70.2	62.8	56.0	52.0	49.2	48.0	46.3	42.9	39.5	33.8	28.1	23.5	19.0	16.1	12.7	10.4
73.6	67.9	58.7	50.1	44.9	42.0	40.3	38.6	36.9	33.4	28.3	24.2	20.2	17.3	13.9	11.6	9.3
74.2	69.1	61.1	53.7	49.7	46.9	45.2	43.5	40.6	37.2	31.5	26.9	22.4	18.4	14.4	12.1	9.8
73.7	69.1	62.3	56.0	52.0	49.2	47.4	46.3	42.3	38.9	32.6	27.5	23.0	19.0	15.0	12.7	9.8
74.2	69.7	64.1	57.3	52.2	49.9	47.7	46.0	42.6	39.8	33.6	27.9	23.4	19.4	16.0	12.7	11.0
75.9	71.3	65.5	58.0	53.9	49.9	48.1	46.4	42.9	39.4	33.6	27.9	23.2	19.7	15.7	12.2	10.5
76.5	73.0	67.2	61.4	57.4	54.5	52.2	49.9	47.0	42.9	36.0	30.7	23.8	20.3	16.8	13.4	11.1
74.8	72.0	68.1	63.0	59.7	56.9	55.2	52.4	48.5	45.1	37.8	31.7	26.1	21.0	17.1	13.7	10.9
74.8	72.5	69.1	64.5	61.1	58.8	57.1	54.9	49.7	46.3	38.9	32.1	26.9	21.2	17.3	13.8	11.0
75.4	73.7	69.7	66.2	62.8	60.5	58.3	56.0	51.4	47.4	40.0	32.6	27.5	21.8	17.8	13.8	11.6
75.9	73.6	70.2	67.3	63.3	61.0	58.7	56.4	51.2	47.8	39.7	33.4	27.1	22.5	17.9	14.5	11.0
75.9	73.7	69.7	66.2	63.4	60.5	58.3	56.0	52.0	46.9	39.5	33.2	26.9	21.8	17.3	13.8	10.4

80	T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=660	T=720	T=780	T=840	T=900	T=1020	T=1380
.1	30.9	25.8	21.8	18.4	15.0	12.1	10.4	8.7	7.0	7.0	7.0	7.0	8.1	7.0
.8	34.8	29.0	24.4	20.3	16.3	13.4	11.1	9.3	7.6	7.0	7.0	7.0	8.2	7.0
.8	29.6	25.5	21.5	18.0	15.1	13.4	11.1	9.3	8.7	7.6	7.6	7.0	7.0	7.0
.2	34.9	29.2	24.1	19.5	16.7	13.3	11.0	8.7	7.6	7.0	7.0	7.0	8.1	7.0
.3	30.2	25.6	21.1	17.7	14.3	12.1	9.8	8.1	7.6	7.0	7.0	7.0	7.6	7.0
.9	36.6	30.9	24.7	20.7	16.7	13.8	11.0	9.3	7.0	6.4	6.4	6.4	7.6	7.0
.0	33.8	29.2	23.5	19.5	16.1	13.3	10.4	9.3	8.1	7.0	6.4	7.0	7.6	7.0
-	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5.3	38.2	31.6	25.6	21.4	17.2	13.6	10.6	8.8	7.0	6.4	6.4	7.0	7.0	7.0
9.4	40.8	34.1	27.3	22.4	17.5	13.8	10.7	8.8	7.0	5.8	6.4	6.4	7.0	7.0
3.1	40.8	33.0	28.2	22.7	17.9	14.9	11.8	9.4	7.6	7.0	6.4	6.4	7.0	7.0
3.0	40.6	33.2	27.5	22.4	17.8	14.4	11.0	9.3	8.1	7.0	6.4	7.0	7.6	7.0
7.4	39.5	32.6	26.4	21.8	16.7	13.8	11.0	8.7	7.0	7.0	6.4	6.4	7.6	7.0
7.4	40.6	33.3	27.2	22.1	17.6	14.3	10.9	9.2	7.6	7.0	7.0	7.0	8.1	7.0
9.5	33.8	28.1	23.5	19.0	16.1	12.7	10.4	8.7	7.6	6.4	6.4	7.0	7.6	7.0
3.4	28.3	24.2	20.2	17.3	13.9	11.6	9.3	8.1	7.0	6.4	7.0	7.0	7.6	7.0
7.2	31.5	26.9	22.4	18.4	14.4	12.1	9.8	8.7	7.6	6.4	6.4	7.0	7.6	7.0
3.9	32.6	27.5	23.0	19.0	15.0	12.7	9.8	8.7	7.0	6.4	7.0	7.0	7.0	7.0
9.8	33.6	27.9	23.4	19.4	16.0	12.7	11.0	8.7	7.6	7.0	6.4	7.0	8.1	7.0
9.4	33.6	27.9	23.2	19.7	15.7	12.2	10.5	8.2	7.6	6.4	6.4	6.4	7.6	7.0
2.9	36.0	30.7	23.8	20.3	16.8	13.4	11.1	8.2	7.0	6.4	5.8	6.4	7.6	7.0
5.1	37.8	31.7	26.1	21.0	17.1	13.7	10.9	9.2	8.1	7.0	6.4	7.0	7.6	7.0
6.3	38.9	32.1	26.9	21.2	17.3	13.8	11.0	8.7	7.6	7.0	6.4	7.0	7.0	7.0
7.4	40.0	32.6	27.5	21.8	17.8	13.8	11.6	9.3	8.1	7.0	6.4	7.0	8.1	7.0
7.8	39.7	33.4	27.1	22.5	17.9	14.5	11.0	9.9	7.6	7.0	6.4	7.0	8.1	7.0
6.9	39.5	33.2	26.9	21.8	17.3	13.8	10.4	8.7	6.4	5.9	5.9	6.4	7.0	7.0

(Sheet 3 of 8)

Table 2 (Continued)

No.	Elev	T=0	T=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150
82	-22.8	76.5	73.1	67.3	58.1	51.2	48.4	46.6	45.5	43.2	40.3
83	-22.8	76.5	73.1	68.0	60.0	54.3	51.4	49.2	47.4	46.3	42.3
84	-22.8	76.5	71.9	67.4	57.1	50.3	47.4	45.2	43.5	42.3	38.9
85	-22.8	76.5	72.0	68.0	61.2	55.6	53.3	51.1	48.8	47.1	43.7
86	-25.5	76.5	75.9	74.8	73.1	70.3	68.1	65.9	62.5	60.2	55.8
87	-48.0	76.5	68.5	63.9	53.5	45.5	44.3	43.2	40.3	39.2	36.3
88	-36.0	76.5	67.4	59.4	44.0	33.8	30.9	29.8	29.2	27.5	25.8
89	-48.0	76.5	68.5	65.7	57.1	52.0	50.3	48.6	46.3	45.2	41.8
90	-48.0	76.5	68.6	65.8	57.3	51.6	49.9	48.8	46.6	44.3	41.5
91	-48.0	76.5	68.0	64.1	53.3	46.6	44.9	43.2	42.0	40.3	37.5
92	-36.0	76.5	68.6	62.9	51.6	44.9	42.6	40.3	39.8	38.1	35.3
93	-36.0	76.5	70.1	64.9	52.8	46.4	44.1	41.8	40.6	39.4	36.5
94	-36.0	76.5	70.8	65.6	55.2	46.6	42.0	39.2	38.0	36.3	34.0
95	-48.0	76.5	72.4	67.8	60.3	51.6	46.4	43.5	41.8	40.6	37.7
96	-48.0	76.5	71.9	66.7	58.0	49.3	44.6	42.3	40.6	39.4	36.5
97	-48.0	76.5	70.8	65.7	56.6	48.6	44.0	40.6	38.3	37.8	34.9
98	-31.0	76.5	73.7	70.3	65.3	59.7	55.2	50.7	46.8	43.4	37.8
99	-42.0	76.5	71.7	66.2	56.6	49.3	43.9	40.8	38.4	36.6	34.2
100	-27.8	76.5	77.7	76.5	63.8	52.3	46.3	43.3	40.8	39.6	37.2
101	-49.5	76.5	71.9	66.7	57.5	48.9	44.3	41.5	39.7	38.6	36.3
102	-21.6	76.5	72.4	67.2	58.4	49.6	44.4	41.5	39.7	38.5	35.6
103	-41.6	76.5	71.3	65.5	55.1	45.3	38.8	34.9	31.0	29.7	27.1
104	-17.5	76.5	73.4	70.3	62.8	57.9	57.3	57.3	46.7	44.9	41.1
105	-35.2	76.5	74.8	69.7	61.8	51.1	43.7	39.8	36.9	35.8	33.6
106	-31.3	76.5	75.4	70.8	64.4	54.1	46.6	42.6	39.7	38.6	36.3
107	-31.3	76.5	75.4	70.8	63.4	53.7	46.3	41.8	39.5	38.3	36.1

l)

T=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150	T=180	T=240	T=300	T=360	T=420	T=480	T=540	T=600
73.1	67.3	58.1	51.2	48.4	46.6	45.5	43.2	40.3	36.9	31.1	26.5	21.9	17.9	14.5	11.6	9.9
73.1	68.0	60.0	54.3	51.4	49.2	47.4	46.3	42.3	38.9	33.2	27.5	22.4	18.4	15.0	12.1	9.8
71.9	67.4	57.1	50.3	47.4	45.2	43.5	42.3	38.9	36.1	30.9	25.8	21.2	17.8	15.0	11.6	9.8
72.0	68.0	61.2	55.6	53.3	51.1	48.8	47.1	43.7	40.3	34.1	28.5	23.4	19.4	15.5	12.7	10.4
75.9	74.8	73.1	70.3	68.1	65.9	62.5	60.2	55.8	51.3	42.9	35.6	29.4	23.8	18.8	14.3	11.5
68.5	63.9	53.5	45.5	44.3	43.2	40.3	39.2	36.3	32.8	28.3	24.2	20.2	16.8	13.9	11.6	9.3
67.4	59.4	44.0	33.8	30.9	29.8	29.2	27.5	25.8	24.7	21.2	18.4	15.5	13.8	12.1	10.4	9.3
68.5	65.7	57.1	52.0	50.3	48.6	46.3	45.2	41.8	38.9	32.1	26.9	22.4	18.4	15.0	12.1	10.4
68.6	65.8	57.3	51.6	49.9	48.8	46.6	44.3	41.5	38.1	32.4	27.3	22.8	18.3	15.5	12.1	10.4
68.0	64.1	53.3	46.6	44.9	43.2	42.0	40.3	37.5	34.7	29.0	25.1	20.6	17.7	14.3	12.1	9.8
68.6	62.9	51.6	44.9	42.6	40.3	39.8	38.1	35.3	33.0	27.9	23.4	20.0	17.2	13.8	12.1	9.8
70.1	64.9	52.8	46.4	44.1	41.8	40.6	39.4	36.5	34.2	28.4	24.4	20.3	17.4	14.5	12.2	9.9
70.8	65.6	55.2	46.6	42.0	39.2	38.0	36.3	34.0	31.7	26.5	22.5	19.1	16.2	13.9	11.6	9.3
72.4	67.8	60.3	51.6	46.4	43.5	41.8	40.6	37.7	34.8	30.2	25.5	21.5	18.0	14.5	12.2	9.9
71.9	66.7	58.0	49.3	44.6	42.3	40.6	39.4	36.5	34.2	29.0	24.4	20.3	17.4	14.5	12.2	10.5
70.8	65.7	56.6	48.6	44.0	40.6	38.3	37.8	34.9	32.1	27.5	23.0	19.5	16.7	13.8	11.0	9.8
73.7	70.3	65.3	59.7	55.2	50.7	46.8	43.4	37.8	33.3	26.6	22.7	19.3	16.5	13.7	11.5	9.8
71.7	66.2	56.6	49.3	43.9	40.8	38.4	36.6	34.2	31.8	26.9	23.3	19.7	16.7	13.6	11.8	10.0
77.7	76.5	63.8	52.3	46.3	43.3	40.8	39.6	37.2	34.2	30.0	25.1	19.1	16.7	14.3	11.8	10.0
71.9	66.7	57.5	48.9	44.3	41.5	39.7	38.6	36.3	33.4	28.3	24.2	19.6	16.8	13.9	11.6	9.9
72.4	67.2	58.4	49.6	44.4	41.5	39.7	38.5	35.6	33.3	28.0	23.9	20.4	16.9	14.0	11.7	9.3
71.3	65.5	55.1	45.3	38.8	34.9	31.0	29.7	27.1	24.5	20.6	16.1	12.8	10.2	8.9	8.3	7.6
73.4	70.3	62.8	57.9	57.3	57.3	46.7	44.9	41.1	37.4	31.8	26.2	21.9	18.2	15.1	12.6	10.1
74.8	69.7	61.8	51.1	43.7	39.8	36.9	35.8	33.6	31.3	26.8	22.8	19.4	16.6	13.8	11.5	9.8
75.4	70.8	64.4	54.1	46.6	42.6	39.7	38.6	36.3	33.4	28.3	23.7	19.6	16.8	13.9	11.0	9.3
75.4	70.8	63.4	53.7	46.3	41.8	39.5	38.3	36.1	33.2	28.1	24.1	20.1	17.3	13.8	11.6	9.8

T=180	T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=660	T=720	T=780	T=840	T=900	T=1020	T=1380
36.9	31.1	26.5	21.9	17.9	14.5	11.6	9.9	8.1	7.0	6.4	6.4	6.4	7.6	7.0
38.9	33.2	27.5	22.4	18.4	15.0	12.1	9.8	8.7	7.0	6.4	7.0	7.0	7.6	7.0
36.1	30.9	25.8	21.2	17.8	15.0	11.6	9.8	8.1	7.6	7.0	6.4	7.0	7.6	7.0
40.3	34.1	28.5	23.4	19.4	15.5	12.7	10.4	8.7	6.4	7.0	6.4	7.0	7.6	7.0
51.3	42.9	35.6	29.4	23.8	18.8	14.3	11.5	9.2	7.6	7.0	7.0	7.0	8.1	7.0
32.8	28.3	24.2	20.2	16.8	13.9	11.6	9.3	8.1	8.1	6.4	6.4	6.4	7.6	7.0
24.7	21.2	18.4	15.5	13.8	12.1	10.4	9.3	8.7	7.0	7.0	7.0	7.0	8.1	7.0
38.9	32.1	26.9	22.4	18.4	15.0	12.1	10.4	8.7	7.0	6.4	6.4	6.4	7.6	7.0
38.1	32.4	27.3	22.8	18.3	15.5	12.1	10.4	8.7	7.6	7.6	7.0	7.0	7.6	7.0
34.7	29.0	25.1	20.6	17.7	14.3	12.1	9.8	8.7	8.1	7.0	6.4	7.0	8.1	7.0
33.0	27.9	23.4	20.0	17.2	13.8	12.1	9.8	8.1	7.0	7.0	6.4	7.0	7.6	7.0
34.2	28.4	24.4	20.3	17.4	14.5	12.2	9.9	8.7	7.6	7.6	7.0	7.0	7.6	7.0
31.7	26.5	22.5	19.1	16.2	13.9	11.6	9.3	8.1	7.6	6.4	6.4	6.4	7.6	7.0
34.8	30.2	25.5	21.5	18.0	14.5	12.2	9.9	8.7	7.6	7.0	7.0	7.0	7.0	7.0
34.2	29.0	24.4	20.3	17.4	14.5	12.2	10.5	8.7	8.2	7.0	7.0	7.0	7.6	7.0
32.1	27.5	23.0	19.5	16.7	13.8	11.0	9.8	8.1	7.0	6.4	6.4	7.0	7.6	7.0
33.3	26.6	22.7	19.3	16.5	13.7	11.5	9.8	8.7	7.6	7.0	6.4	7.0	7.6	7.0
31.8	26.9	23.3	19.7	16.7	13.6	11.8	10.0	8.2	7.0	6.4	6.4	6.4	7.0	7.0
34.2	30.0	25.1	19.1	16.7	14.3	11.8	10.0	8.2	7.6	7.0	6.4	7.0	7.6	7.0
33.4	28.3	24.2	19.6	16.8	13.9	11.6	9.9	8.1	7.0	6.4	6.4	7.0	7.0	7.0
33.3	28.0	23.9	20.4	16.9	14.0	11.7	9.3	7.6	7.6	7.0	6.4	7.0	7.6	7.0
24.5	20.6	16.1	12.8	10.2	8.9	8.3	7.6	7.0	7.0	7.0	7.0	7.0	7.0	7.0
37.4	31.8	26.2	21.9	18.2	15.1	12.6	10.1	8.9	7.0	7.0	7.0	7.0	7.6	7.0
31.3	26.8	22.8	19.4	16.6	13.8	11.5	9.8	8.1	7.0	7.0	7.0	7.0	7.6	7.0
33.4	28.3	23.7	19.6	16.8	13.9	11.0	9.3	8.1	7.0	6.4	6.4	6.4	7.0	7.0
33.2	28.1	24.1	20.1	17.3	13.8	11.6	9.8	8.1	7.6	7.0	6.4	6.4	7.6	7.0

(Sheet 4 of 8)

Table 2 (Continued)

No.	Elev	T=0	T=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150
108	-23.1	76.5	75.4	71.4	63.5	52.2	43.7	38.6	36.4	35.3	33.0
109	-23.1	76.5	75.9	72.0	65.8	56.7	50.5	46.0	43.2	41.5	38.6
110	-22.8	76.5	75.3	71.2	63.5	52.9	44.7	39.4	36.4	35.3	32.3
111	-22.8	76.5	75.4	71.9	66.2	58.1	51.2	47.2	44.3	43.2	39.7
112	-22.4	76.5	75.9	70.8	63.4	52.0	43.5	39.5	36.1	34.9	32.6
113	-22.4	76.5	75.3	72.3	67.0	59.3	53.9	50.4	48.0	46.8	43.8
114	-28.0	76.5	75.9	71.4	64.6	56.2	49.4	45.4	42.6	41.5	38.6
114A	-28.0	76.5	75.9	72.0	66.3	59.0	51.6	46.6	42.6	39.8	36.9
115	-28.0	76.5	75.4	72.5	67.9	60.4	55.2	51.2	48.9	47.8	43.8
116	-28.0	76.5	76.5	74.2	70.8	65.0	59.8	56.4	54.7	51.8	47.8
117	-28.0	76.5	76.5	74.2	70.8	65.7	61.7	58.8	56.6	54.3	50.3
118	-28.0	76.5	75.4	74.2	71.4	67.5	62.9	60.1	57.9	55.6	51.1
119	-28.0	—	—	—	—	—	—	—	—	—	—
119A	-28.0	76.5	76.5	74.7	71.2	66.6	61.9	59.6	56.6	54.9	50.2
120	-23.5	76.5	75.9	75.2	73.9	57.4	47.2	41.4	37.6	36.3	33.8
121	-23.5	76.5	75.3	72.4	66.1	56.8	49.3	45.2	41.8	40.6	37.1
122	-22.8	76.5	75.4	72.0	65.8	56.7	49.9	45.4	42.6	40.9	37.5
123	-22.8	76.5	75.3	70.7	63.2	52.8	44.1	40.0	37.7	36.0	33.6
124	-28.0	76.5	75.9	73.1	66.7	58.1	50.7	45.5	43.2	40.9	37.4
124A	-28.0	76.5	75.4	72.5	65.6	56.4	48.4	43.8	41.5	40.3	37.4
125	-28.0	76.5	76.5	74.1	69.4	62.2	55.7	51.6	48.6	46.2	42.0
126	-28.0	76.5	76.5	74.8	71.4	66.2	60.5	57.7	54.3	52.0	48.6
127	-28.0	76.5	75.4	74.8	71.3	66.7	62.1	58.7	56.4	53.5	50.1
128	-28.0	76.5	77.6	74.2	71.3	66.7	62.1	59.8	57.5	54.7	51.2
129	-28.0	76.5	75.3	74.2	71.2	67.2	63.7	60.7	57.8	55.5	51.4
129A	-28.0	76.5	77.1	75.4	71.9	67.3	63.3	61.0	58.7	56.4	51.2

=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150	T=180	T=240	T=300	T=360	T=420	T=480	T=540	T=600
.4	71.4	63.5	52.2	43.7	38.6	36.4	35.3	33.0	30.7	26.2	22.3	18.3	15.5	13.2	11.0	9.3
.9	72.0	65.8	56.7	50.5	46.0	43.2	41.5	38.6	35.8	30.2	25.6	21.1	17.7	14.3	12.1	9.8
.3	71.2	63.5	52.9	44.7	39.4	36.4	35.3	32.3	30.6	26.4	22.3	18.8	15.8	13.5	11.1	9.4
.4	71.9	66.2	58.1	51.2	47.2	44.3	43.2	39.7	36.9	31.7	26.5	21.9	18.5	15.0	12.2	9.9
.9	70.8	63.4	52.0	43.5	39.5	36.1	34.9	32.6	29.8	25.8	22.4	19.0	16.1	13.3	11.0	9.3
.3	72.3	67.0	59.3	53.9	50.4	48.0	46.8	43.8	42.0	39.7	39.1	37.9	37.3	15.3	12.9	10.6
.9	71.4	64.6	56.2	49.4	45.4	42.6	41.5	38.6	35.8	30.7	25.6	21.7	17.7	14.9	12.1	9.8
.9	72.0	66.3	59.0	51.6	46.6	42.6	39.8	36.9	33.6	29.0	24.5	20.0	17.2	14.3	11.5	9.8
.4	72.5	67.9	60.4	55.2	51.2	48.9	47.8	43.8	40.9	34.0	28.3	23.7	19.6	15.6	12.7	9.9
.5	74.2	70.8	65.0	59.8	56.4	54.7	51.8	47.8	44.3	38.0	31.1	26.0	20.2	16.8	13.3	11.0
.5	74.2	70.8	65.7	61.7	58.8	56.6	54.3	50.3	45.7	38.9	32.1	26.9	21.8	17.8	13.8	11.0
.4	74.2	71.4	67.5	62.9	60.1	57.9	55.6	51.1	46.6	39.2	33.0	26.8	21.1	17.2	13.8	11.0
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
.5	74.7	71.2	66.6	61.9	59.6	56.6	54.9	50.2	46.7	38.5	32.1	26.9	21.0	17.5	13.4	10.5
.9	75.2	73.9	57.4	47.2	41.4	37.6	36.3	33.8	31.9	27.4	23.6	19.8	16.6	14.0	12.1	9.6
.3	72.4	66.1	56.8	49.3	45.2	41.8	40.6	37.1	34.8	29.6	25.0	20.3	16.8	14.5	11.6	9.9
.4	72.0	65.8	56.7	49.9	45.4	42.6	40.9	37.5	35.3	30.2	25.1	21.1	17.7	14.9	12.1	10.4
.3	70.7	63.2	52.8	44.1	40.0	37.7	36.0	33.6	31.9	27.3	22.6	19.2	16.3	14.0	11.6	9.9
.9	73.1	66.7	58.1	50.7	45.5	43.2	40.9	37.4	35.1	30.0	25.4	21.4	16.8	14.5	11.6	9.3
.4	72.5	65.6	56.4	48.4	43.8	41.5	40.3	37.4	34.0	28.8	24.8	20.2	16.8	13.9	11.6	9.3
.5	74.1	69.4	62.2	55.7	51.6	48.6	46.2	42.0	39.7	34.3	28.4	23.0	19.5	15.3	12.9	10.6
.5	74.8	71.4	66.2	60.5	57.7	54.3	52.0	48.6	44.6	38.3	31.5	25.8	21.8	17.3	13.8	11.0
.4	74.8	71.3	66.7	62.1	58.7	56.4	53.5	50.1	46.1	38.6	32.3	26.5	21.4	17.3	13.3	11.0
.6	74.2	71.3	66.7	62.1	59.8	57.5	54.7	51.2	46.6	39.7	32.8	27.1	21.4	16.8	13.3	10.4
.3	74.2	71.2	67.2	63.7	60.7	57.8	55.5	51.4	47.9	39.7	32.7	27.4	22.2	17.5	14.0	11.1
.1	75.4	71.9	67.3	63.3	61.0	58.7	56.4	51.2	47.8	39.7	32.8	26.5	21.4	17.3	13.9	11.0

180	T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=660	T=720	T=780	T=840	T=900	T=1020	T=1380
.7	26.2	22.3	18.3	15.5	13.2	11.0	9.3	7.6	7.0	6.4	6.4	7.0	7.6	7.0
.8	30.2	25.6	21.1	17.7	14.3	12.1	9.8	8.1	7.0	6.4	6.4	6.4	7.6	7.0
.6	26.4	22.3	18.8	15.8	13.5	11.1	9.4	8.2	7.0	7.0	6.4	7.0	7.0	7.0
.9	31.7	26.5	21.9	18.5	15.0	12.2	9.9	8.1	7.0	6.4	6.4	6.4	7.0	7.0
.8	25.8	22.4	19.0	16.1	13.3	11.0	9.3	7.6	7.0	6.4	6.4	7.0	7.6	7.0
.0	39.7	39.1	37.9	37.3	15.3	12.9	10.6	8.8	7.6	7.0	7.0	7.0	7.6	7.0
.8	30.7	25.6	21.7	17.7	14.9	12.1	9.8	8.1	7.0	7.0	6.4	7.0	7.6	7.0
.6	29.0	24.5	20.0	17.2	14.3	11.5	9.8	8.7	7.6	7.0	6.4	7.0	7.6	7.0
.9	34.0	28.3	23.7	19.6	15.6	12.7	9.9	8.1	7.0	6.4	5.9	6.4	7.0	7.0
.3	38.0	31.1	26.0	20.2	16.8	13.3	11.0	8.7	7.0	6.4	5.9	7.0	7.0	7.0
.7	38.9	32.1	26.9	21.8	17.8	13.8	11.0	8.7	7.6	7.0	7.0	7.0	7.6	7.0
.6	39.2	33.0	26.8	21.1	17.2	13.8	11.0	8.7	7.6	6.4	6.4	6.4	7.6	7.0
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
.7	38.5	32.1	26.9	21.0	17.5	13.4	10.5	8.8	7.6	6.4	6.4	7.0	7.6	7.0
.9	27.4	23.6	19.8	16.6	14.0	12.1	9.6	8.3	7.6	7.0	6.4	7.0	8.3	7.0
.8	29.6	25.0	20.3	16.8	14.5	11.6	9.9	8.2	7.0	6.4	6.4	6.4	7.0	7.0
.3	30.2	25.1	21.1	17.7	14.9	12.1	10.4	8.7	7.6	7.0	6.4	7.0	7.6	7.0
.9	27.3	22.6	19.2	16.3	14.0	11.6	9.9	8.7	7.6	6.4	6.4	7.0	8.2	7.0
.1	30.0	25.4	21.4	16.8	14.5	11.6	9.3	8.1	7.6	6.4	5.9	5.9	6.4	7.0
.0	28.8	24.8	20.2	16.8	13.9	11.6	9.3	7.6	7.0	5.9	5.9	6.4	7.0	7.0
.7	34.3	28.4	23.0	19.5	15.3	12.9	10.6	8.8	7.0	6.4	5.8	6.4	7.0	7.0
.6	38.3	31.5	25.8	21.8	17.3	13.8	11.0	9.3	7.6	6.4	6.4	7.0	7.6	7.0
.1	38.6	32.3	26.5	21.4	17.3	13.3	11.0	8.7	7.0	7.0	5.9	6.4	7.0	7.0
.6	39.7	32.8	27.1	21.4	16.8	13.3	10.4	8.1	7.0	5.9	5.9	6.4	6.4	7.0
.9	39.7	32.7	27.4	22.2	17.5	14.0	11.1	9.3	7.6	7.0	6.4	7.0	7.6	7.0
.8	39.7	32.8	26.5	21.4	17.3	13.9	11.0	8.7	7.6	6.4	6.4	6.4	7.6	7.0

(Sheet 5 of 8)

Table 2 (Continued)

No.	Elev	T=0	T=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=1
130	-22.8	76.5	75.9	71.9	64.0	53.7	46.3	41.2	38.9	37.8	34.
131	-22.8	76.5	74.8	71.9	63.8	54.5	48.1	44.6	42.9	40.6	37.
132	-22.8	76.5	74.8	70.8	63.9	54.7	48.9	45.5	43.2	42.0	39.
133	-22.8	76.5	73.7	70.8	61.7	50.3	41.2	36.1	33.8	32.6	30.
134	-48.0	76.5	71.5	64.6	52.7	45.2	44.6	43.9	28.9	27.7	26.
135	-48.0	76.5	73.1	66.2	55.8	44.9	36.9	32.8	30.5	29.4	28.
136	-48.0	76.5	73.0	67.1	57.1	46.5	38.8	34.7	33.5	31.7	30.
137	-36.0	76.5	73.6	67.8	60.9	52.2	46.4	44.1	42.3	40.6	37.
138	-36.0	76.5	72.5	67.3	59.3	49.5	43.2	40.9	39.7	37.4	35.
139	-48.0	76.5	72.5	65.8	55.6	43.7	35.8	33.0	31.3	29.6	28.
140	-47.0	76.5	73.0	68.3	60.7	54.3	49.1	46.7	46.1	44.4	41.
141	-51.0	76.5	73.0	68.3	61.8	55.3	51.2	48.8	46.5	45.3	41.
142	-45.0	76.5	72.3	68.2	59.3	50.4	44.4	41.5	40.9	39.7	37.
143	-49.0	76.5	73.0	67.7	60.0	50.0	42.9	40.6	39.4	37.6	35.
144	-31.0	76.5	72.9	67.0	56.9	45.6	38.5	34.9	33.7	31.9	30.
144A	-31.0	76.5	73.6	68.3	60.7	52.6	46.1	42.0	39.7	38.5	35.
145	-51.4	—	—	—	—	—	—	—	—	—	—
146	-49.0	76.5	72.5	66.7	58.7	48.4	42.0	39.2	37.4	36.3	34.
147	-46.6	76.5	71.4	65.1	53.7	41.2	32.6	29.2	26.9	26.4	25.
148	-45.0	76.5	71.3	64.3	52.2	40.0	33.1	29.6	27.9	27.3	25.
149	-45.0	76.5	70.7	64.2	53.1	39.7	30.4	26.3	24.5	23.4	22.
149A	-45.0	76.5	70.5	63.3	50.7	38.2	30.4	26.2	25.0	24.4	23.
150	-45.0	76.5	69.6	62.0	49.3	36.5	28.4	25.0	23.2	22.6	22.
151	-38.0	76.5	68.4	59.7	45.8	30.7	22.1	18.6	18.0	17.4	18.
152	-38.0	76.5	69.9	63.3	61.3	43.4	33.5	30.2	28.8	28.2	26.
153	-38.0	76.5	69.0	60.4	47.2	32.3	23.1	19.1	17.3	16.8	16.

T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150	T=180	T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=660	T=7
71.9	64.0	53.7	46.3	41.2	38.9	37.8	34.9	32.1	27.5	23.5	19.5	16.7	13.8	12.1	9.8	8.1	7
71.9	63.8	54.5	48.1	44.6	42.9	40.6	37.7	35.4	30.2	25.5	21.5	17.4	15.1	12.2	10.5	8.7	7
70.8	63.9	54.7	48.9	45.5	43.2	42.0	39.2	36.3	31.1	25.4	21.4	17.9	14.5	11.6	9.9	7.6	7
70.8	61.7	50.3	41.2	36.1	33.8	32.6	30.4	28.6	24.7	21.2	17.8	15.0	12.7	11.0	9.3	7.6	7
64.6	52.7	45.2	44.6	43.9	28.9	27.7	26.4	24.5	21.4	18.9	15.8	14.5	12.0	10.1	8.9	8.3	7
66.2	55.8	44.9	36.9	32.8	30.5	29.4	28.3	26.0	22.5	19.6	17.3	14.5	12.2	10.4	8.7	8.1	7
67.1	57.1	46.5	38.8	34.7	33.5	31.7	30.0	28.2	24.1	21.1	17.6	15.2	12.9	11.1	9.4	8.2	7
67.8	60.9	52.2	46.4	44.1	42.3	40.6	37.7	34.2	29.6	25.0	20.9	17.4	14.5	11.6	9.9	8.2	7
67.3	59.3	49.5	43.2	40.9	39.7	37.4	35.1	32.8	27.1	23.7	19.6	16.8	13.9	11.6	9.9	8.1	7
65.8	55.6	43.7	35.8	33.0	31.3	29.6	28.5	26.2	22.3	19.4	16.6	14.3	12.1	10.4	8.7	8.1	7
68.3	60.7	54.3	49.1	46.7	46.1	44.4	41.5	38.0	32.1	27.4	22.2	18.7	15.2	12.8	9.9	8.2	7
68.3	61.8	55.3	51.2	48.8	46.5	45.3	41.8	38.2	32.9	27.6	22.3	18.8	15.2	12.3	9.9	8.8	6
68.2	59.3	50.4	44.4	41.5	40.9	39.7	37.3	34.3	28.4	24.8	20.7	17.1	14.1	12.3	10.0	8.2	7
67.7	60.0	50.0	42.9	40.6	39.4	37.6	35.3	32.9	28.2	24.1	20.0	16.4	14.1	11.7	9.9	8.8	8
67.0	56.9	45.6	38.5	34.9	33.7	31.9	30.2	27.8	24.2	20.7	18.3	14.7	12.9	11.2	9.4	8.2	7
68.3	60.7	52.6	46.1	42.0	39.7	38.5	35.6	33.3	28.0	24.5	20.4	16.9	14.0	11.7	9.9	8.2	7
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
66.7	58.7	48.4	42.0	39.2	37.4	36.3	34.6	31.1	27.1	23.1	19.6	16.8	13.9	12.2	9.9	9.3	7
65.1	53.7	41.2	32.6	29.2	26.9	26.4	25.2	23.0	20.1	17.8	15.5	13.3	11.6	9.8	8.7	7.6	7
64.3	52.2	40.0	33.1	29.6	27.9	27.3	25.5	24.4	20.9	18.0	15.7	14.0	11.6	9.9	8.7	8.2	7
64.2	53.1	39.7	30.4	26.3	24.5	23.4	22.8	21.0	18.7	16.9	14.6	12.8	11.7	9.9	8.8	8.2	7
63.3	50.7	38.2	30.4	26.2	25.0	24.4	23.2	21.4	19.0	16.6	14.2	12.4	10.6	9.4	8.8	7.6	7
62.0	49.3	36.5	28.4	25.0	23.2	22.6	22.1	20.3	18.0	15.7	14.0	11.6	10.5	9.3	8.2	7.0	6
59.7	45.8	30.7	22.1	18.6	18.0	17.4	18.0	16.3	14.5	13.4	12.2	10.5	9.9	9.3	8.2	7.6	7
63.3	61.3	43.4	33.5	30.2	28.8	28.2	26.9	24.9	22.2	18.9	16.9	14.3	13.0	11.0	9.0	8.3	7
60.4	47.2	32.3	23.1	19.1	17.3	16.8	16.8	15.6	13.9	12.7	11.6	11.0	9.3	8.7	7.6	7.0	7

80	T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=660	T=720	T=780	T=840	T=900	T=1020	T=1380
.1	27.5	23.5	19.5	16.7	13.8	12.1	9.8	8.1	7.6	6.4	6.4	6.4	7.6	7.0
.4	30.2	25.5	21.5	17.4	15.1	12.2	10.5	8.7	7.6	7.0	7.0	7.0	8.2	7.0
.3	31.1	25.4	21.4	17.9	14.5	11.6	9.9	7.6	7.0	6.4	6.4	6.4	7.0	7.0
.6	24.7	21.2	17.8	15.0	12.7	11.0	9.3	7.6	7.0	6.4	6.4	6.4	7.6	7.0
.5	21.4	18.9	15.8	14.5	12.0	10.1	8.9	8.3	7.6	6.4	7.0	6.4	7.6	7.0
.0	22.5	19.6	17.3	14.5	12.2	10.4	8.7	8.1	7.0	7.0	6.4	6.4	7.6	7.0
.2	24.1	21.1	17.6	15.2	12.9	11.1	9.4	8.2	7.6	7.0	7.0	6.4	7.6	7.0
.2	29.6	25.0	20.9	17.4	14.5	11.6	9.9	8.2	7.0	6.4	6.4	6.4	7.0	7.0
.8	27.1	23.7	19.6	16.8	13.9	11.6	9.9	8.1	7.6	6.4	7.0	6.4	7.0	7.0
.2	22.3	19.4	16.6	14.3	12.1	10.4	8.7	8.1	7.6	6.4	6.4	6.4	7.6	7.0
.0	32.1	27.4	22.2	18.7	15.2	12.8	9.9	8.2	7.0	6.4	6.4	7.0	7.0	7.0
.2	32.9	27.6	22.3	18.8	15.2	12.3	9.9	8.8	6.4	6.4	6.4	7.0	7.6	7.0
.3	28.4	24.8	20.7	17.1	14.1	12.3	10.0	8.2	7.0	7.0	6.4	7.0	7.6	7.0
.9	28.2	24.1	20.0	16.4	14.1	11.7	9.9	8.8	8.2	7.0	6.4	7.0	7.6	7.0
.8	24.2	20.7	18.3	14.7	12.9	11.2	9.4	8.2	7.6	6.4	6.4	7.0	7.6	7.0
.3	28.0	24.5	20.4	16.9	14.0	11.7	9.9	8.2	7.0	7.0	5.8	5.8	7.0	7.0
	—	—	—	—	—	—	—	—	—	—	—	—	—	—
.1	27.1	23.1	19.6	16.8	13.9	12.2	9.9	9.3	7.0	7.0	7.0	7.6	7.6	7.0
.0	20.1	17.8	15.5	13.3	11.6	9.8	8.7	7.6	7.0	6.4	6.4	6.4	7.6	7.0
.4	20.9	18.0	15.7	14.0	11.6	9.9	8.7	8.2	7.6	7.0	6.4	7.0	7.6	7.0
.0	18.7	16.9	14.6	12.8	11.7	9.9	8.8	8.2	7.6	7.6	7.0	7.0	7.0	7.0
.4	19.0	16.6	14.2	12.4	10.6	9.4	8.8	7.6	7.6	6.4	7.0	6.4	7.6	7.0
.3	18.0	15.7	14.0	11.6	10.5	9.3	8.2	7.0	6.4	6.4	5.8	6.4	7.0	7.0
.3	14.5	13.4	12.2	10.5	9.9	9.3	8.2	7.6	7.0	7.0	7.0	7.0	7.6	7.0
.9	22.2	18.9	16.9	14.3	13.0	11.0	9.0	8.3	7.7	7.0	7.7	7.7	7.7	7.0
.6	13.9	12.7	11.6	11.0	9.3	8.7	7.6	7.0	7.0	7.0	6.4	7.0	7.6	7.0

(Sheet 6 of 8)

Table 2 (Continued)

No.	Elev.	T=0	T=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150
154	-38.0	—	—	—	—	—	—	—	—	—	—
155	-38.0	76.5	69.0	60.4	46.1	31.1	21.9	18.5	17.3	16.8	16.8
156	-38.0	—	—	—	—	—	—	—	—	—	—
157	-31.0	76.5	65.8	58.1	43.2	30.8	23.6	21.9	20.7	20.7	20.1
158	-31.0	76.5	66.7	58.5	44.1	30.7	23.8	21.5	20.9	20.9	20.3
159	5.0	76.5	65.2	58.1	42.6	29.0	23.0	20.7	20.7	20.1	19.5
160	5.0	7.0	2.9	3.5	3.5	22.6	21.5	19.7	19.2	19.7	18.6
161	-31.0	7.0	3.6	-3.3	-2.7	10.4	16.1	17.3	17.3	17.3	17.3
162	-31.0	7.0	3.5	-4.5	-3.4	12.2	19.7	20.2	19.7	19.7	19.7
163	-31.0	7.0	2.3	-3.6	-1.8	14.6	17.0	17.6	17.0	18.2	17.0
164	-31.0	7.0	3.0	-3.3	-3.9	13.9	19.0	19.0	18.4	18.4	17.9
165	-31.0	7.0	3.5	-0.5	3.5	16.3	19.8	19.2	18.6	19.2	18.6
166	-31.0	7.0	4.7	-0.5	6.4	16.9	19.8	19.2	18.0	18.6	18.0
167	-31.0	7.0	5.8	4.1	8.7	17.4	18.6	17.4	16.8	17.4	16.8
167A	-31.0	7.0	8.2	3.5	9.3	20.4	21.5	20.4	19.8	19.8	19.2
168	-28.5	7.0	9.3	9.3	13.4	12.8	12.8	11.6	11.6	11.6	11.6
169	-24.0	7.0	10.6	12.4	17.9	20.9	20.9	19.7	19.1	19.7	18.5
170	-21.0	7.0	10.0	12.3	17.7	21.2	21.8	20.6	20.0	20.0	20.0
171	-27.0	7.0	7.6	7.6	6.4	4.7	3.0	1.8	1.2	1.8	2.4
172	-27.0	7.0	8.7	12.8	17.9	23.7	26.6	26.0	26.0	25.4	24.3
173	-27.0	7.0	8.2	8.2	5.2	2.9	0.5	-0.7	-0.7	-0.1	1.1
174	-27.0	7.0	8.2	12.3	17.6	22.8	25.8	25.8	25.8	25.2	24.0
175	-27.0	7.0	8.9	8.9	6.1	5.1	1.4	-0.5	-0.5	0.5	2.3
176	-27.0	7.0	8.7	13.4	19.8	25.0	27.4	26.8	26.8	25.6	24.5
177	-34.0	7.0	8.2	11.6	14.5	16.8	17.4	16.8	16.3	16.3	16.3
178	-34.0	7.0	9.3	11.5	15.3	18.3	18.3	18.3	17.5	17.5	18.3

T=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150	T=180	T=240	T=300	T=360	T=420	T=480	T=540	T=600
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
9.0	60.4	46.1	31.1	21.9	18.5	17.3	16.8	16.8	15.6	13.9	12.7	11.6	10.4	9.3	8.1	8.1
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5.8	58.1	43.2	30.8	23.6	21.9	20.7	20.7	20.1	18.3	16.5	14.7	12.9	11.2	10.0	8.8	8.2
6.7	58.5	44.1	30.7	23.8	21.5	20.9	20.9	20.3	19.2	16.3	14.5	13.4	12.2	10.5	9.3	8.7
5.2	58.1	42.6	29.0	23.0	20.7	20.7	20.1	19.5	18.3	15.9	14.7	12.3	11.2	10.0	8.8	7.6
2.9	3.5	3.5	22.6	21.5	19.7	19.2	19.7	18.6	18.0	15.1	14.5	12.8	11.1	9.9	9.3	8.2
3.6	-3.3	-2.7	10.4	16.1	17.3	17.3	17.3	17.3	16.7	15.0	14.4	12.7	11.6	9.9	9.3	8.7
3.5	-4.5	-3.4	12.2	19.7	20.2	19.7	19.7	19.7	17.9	16.2	14.5	12.8	11.6	10.5	9.3	8.7
2.3	-3.6	-1.8	14.6	17.0	17.6	17.0	18.2	17.0	16.4	15.2	14.0	12.3	11.7	9.9	9.3	8.8
3.0	-3.3	-3.9	13.9	19.0	19.0	18.4	18.4	17.9	16.1	15.0	13.3	12.1	11.0	9.3	8.7	7.6
3.5	-0.5	3.5	16.3	19.8	19.2	18.6	19.2	18.6	18.0	16.9	15.7	15.1	13.4	12.8	11.6	11.1
4.7	-0.5	6.4	16.9	19.8	19.2	18.0	18.6	18.0	16.9	16.3	15.1	14.0	12.8	12.2	11.1	9.9
5.8	4.1	8.7	17.4	18.6	17.4	16.8	17.4	16.8	15.7	13.9	12.8	11.6	10.5	9.3	8.7	8.2
8.2	3.5	9.3	20.4	21.5	20.4	19.8	19.8	19.2	17.5	16.3	14.0	12.2	11.1	9.9	9.3	8.7
9.3	9.3	13.4	12.8	12.8	11.6	11.6	11.6	11.6	11.1	10.5	10.5	10.5	9.9	9.3	8.7	8.7
10.6	12.4	17.9	20.9	20.9	19.7	19.1	19.7	18.5	17.9	16.1	14.9	13.7	11.8	10.6	10.0	8.8
10.0	12.3	17.7	21.2	21.8	20.6	20.0	20.0	20.0	18.3	15.9	14.1	13.5	11.1	10.6	9.4	8.8
7.6	7.6	6.4	4.7	3.0	1.8	1.2	1.8	2.4	3.0	3.5	4.7	5.3	5.8	5.8	5.8	6.4
8.7	12.8	17.9	23.7	26.6	26.0	26.0	25.4	24.3	22.5	19.7	17.4	15.1	13.3	11.6	10.5	9.3
8.2	8.2	5.2	2.9	0.5	-0.7	-0.7	-0.1	1.1	1.1	2.3	4.0	4.6	5.2	5.8	6.4	7.0
8.2	12.3	17.6	22.8	25.8	25.8	25.8	25.2	24.0	22.8	19.9	17.6	14.6	12.9	11.1	9.3	8.8
8.9	8.9	6.1	5.1	1.4	-0.5	-0.5	0.5	2.3	1.4	3.3	5.1	5.1	6.1	6.1	6.1	7.0
8.7	13.4	19.8	25.0	27.4	26.8	26.8	25.6	24.5	22.7	20.4	17.5	15.7	13.4	11.7	10.5	9.3
8.2	11.6	14.5	16.8	17.4	16.8	16.3	16.3	16.3	14.5	14.0	12.8	11.1	10.5	9.3	8.7	8.7
9.3	11.5	15.3	18.3	18.3	18.3	17.5	17.5	18.3	16.0	15.3	13.8	12.3	11.5	10.8	9.3	9.3

180	T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=660	T=720	T=780	T=840	T=900	T=1020	T=1380
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5.6	13.9	12.7	11.6	10.4	9.3	8.1	8.1	7.6	7.6	7.0	6.4	6.4	7.0	7.0
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
8.3	16.5	14.7	12.9	11.2	10.0	8.8	8.2	7.0	6.4	5.8	6.4	6.4	7.0	7.0
9.2	16.3	14.5	13.4	12.2	10.5	9.3	8.7	7.6	7.6	7.0	7.0	7.0	7.0	7.0
8.3	15.9	14.7	12.3	11.2	10.0	8.8	7.6	7.6	6.4	6.4	6.4	6.4	7.0	7.0
8.0	15.1	14.5	12.8	11.1	9.9	9.3	8.2	7.6	7.6	7.0	6.4	7.0	7.6	6.4
6.7	15.0	14.4	12.7	11.6	9.9	9.3	8.7	7.6	7.6	7.6	7.0	7.0	7.0	7.6
7.9	16.2	14.5	12.8	11.6	10.5	9.3	8.7	8.2	7.0	7.0	7.0	7.0	7.6	7.6
6.4	15.2	14.0	12.3	11.7	9.9	9.3	8.8	8.2	7.6	7.0	7.0	7.0	7.6	7.6
6.1	15.0	13.3	12.1	11.0	9.3	8.7	7.6	7.6	7.0	7.0	6.4	6.4	7.0	7.0
8.0	16.9	15.7	15.1	13.4	12.8	11.6	11.1	10.5	9.9	9.3	9.3	9.9	9.3	8.7
6.9	16.3	15.1	14.0	12.8	12.2	11.1	9.9	9.9	8.7	8.7	8.7	8.7	8.7	8.7
5.7	13.9	12.8	11.6	10.5	9.3	8.7	8.2	7.6	7.0	7.0	7.0	6.4	7.0	7.0
7.5	16.3	14.0	12.2	11.1	9.9	9.3	8.7	8.2	7.6	7.0	7.0	7.6	7.6	7.6
1.1	10.5	10.5	10.5	9.9	9.3	8.7	8.7	8.2	7.6	7.6	7.0	7.6	7.6	7.6
7.9	16.1	14.9	13.7	11.8	10.6	10.0	8.8	8.2	8.2	7.6	8.2	7.6	8.2	7.6
8.3	15.9	14.1	13.5	11.1	10.6	9.4	8.8	7.6	7.0	7.0	7.0	7.0	7.0	7.6
3.0	3.5	4.7	5.3	5.8	5.8	5.8	6.4	6.4	6.4	6.4	6.4	6.4	6.4	6.4
2.5	19.7	17.4	15.1	13.3	11.6	10.5	9.3	8.7	7.6	7.6	7.6	7.6	7.6	7.6
1.1	2.3	4.0	4.6	5.2	5.8	6.4	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
2.8	19.9	17.6	14.6	12.9	11.1	9.3	8.8	7.6	7.6	7.0	7.0	7.0	7.0	6.4
1.4	3.3	5.1	5.1	6.1	6.1	6.1	7.0	7.0	7.0	7.0	7.0	6.1	7.0	7.0
2.7	20.4	17.5	15.7	13.4	11.7	10.5	9.3	8.7	7.6	7.6	7.0	7.0	7.0	7.0
4.5	14.0	12.8	11.1	10.5	9.3	8.7	8.7	7.6	7.6	7.0	7.6	7.6	7.6	7.0
6.0	15.3	13.8	12.3	11.5	10.8	9.3	9.3	8.5	8.5	7.8	7.8	7.8	7.8	7.8

(Sheet 7 of 8)

Table 2 (Concluded)

No.	Elev	T=0	T=15	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150
179	-34.0	7.0	8.2	11.1	14.5	17.4	18.6	18.0	17.4	16.8	16.8
180	-34.0	7.0	7.6	11.6	17.4	20.9	22.1	22.1	20.9	20.9	20.3
181	-34.0	7.0	7.6	12.2	17.3	21.9	23.0	24.2	23.0	22.5	21.3
182	-31.8	7.0	8.2	10.5	16.2	20.3	20.9	19.7	19.7	20.3	18.5
183	-31.8	7.0	8.2	11.7	14.7	22.9	24.1	25.9	25.9	24.7	25.9
184	-31.8	7.0	8.2	10.5	14.0	18.0	18.6	20.3	20.3	20.3	20.3
185	-31.8	—	—	—	—	—	—	—	—	—	—
186	-27.0	7.0	8.2	7.6	5.2	1.7	-1.9	-3.1	-3.7	-1.9	-0.1
187	-27.0	7.0	8.7	12.8	18.0	23.2	24.9	24.3	24.3	23.8	22.6
188	-34.0	7.0	8.7	10.4	12.6	13.7	13.7	13.2	13.2	13.2	13.7
189	-34.0	—	—	—	—	—	—	—	—	—	—
190	-34.0	7.0	8.1	10.4	12.6	13.7	14.8	13.7	13.1	12.6	13.1
191	-34.0	—	—	—	—	—	—	—	—	—	—
192	-34.0	7.0	8.2	11.3	16.2	20.5	20.5	20.5	20.5	19.9	19.9

5	T=30	T=45	T=60	T=75	T=90	T=105	T=120	T=150	T=180	T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=660
2	11.1	14.5	17.4	18.6	18.0	17.4	16.8	16.8	15.7	14.0	12.8	11.6	10.5	9.3	8.7	8.2	7.6
6	11.6	17.4	20.9	22.1	22.1	20.9	20.9	20.3	18.6	16.8	15.1	12.8	11.6	10.5	9.3	8.7	8.2
6	12.2	17.3	21.9	23.0	24.2	23.0	22.5	21.3	19.6	17.9	15.6	13.9	12.2	10.4	9.3	8.7	8.1
2	10.5	16.2	20.3	20.9	19.7	19.7	20.3	18.5	18.0	15.7	13.9	11.6	10.5	10.5	8.7	8.2	7.6
2	11.7	14.7	22.9	24.1	25.9	25.9	24.7	25.9	20.6	18.2	15.8	12.9	11.7	10.5	9.9	8.2	8.2
2	10.5	14.0	18.0	18.6	20.3	20.3	20.3	20.3	17.4	16.9	15.1	12.8	11.1	10.5	9.3	8.7	8.2
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	7.6	5.2	1.7	-1.9	-3.1	-3.7	-1.9	-0.1	-0.1	1.1	2.8	4.0	4.6	5.8	6.4	6.4	7.0
7	12.8	18.0	23.2	24.9	24.3	24.3	23.8	22.6	21.5	18.6	16.2	14.5	12.8	11.0	9.9	8.7	7.6
7	10.4	12.6	13.7	13.7	13.2	13.2	13.2	13.7	12.6	12.1	11.5	10.4	9.8	9.2	8.7	8.1	8.1
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1	10.4	12.6	13.7	14.8	13.7	13.1	12.6	13.1	12.6	13.1	12.0	11.5	10.4	9.8	8.1	7.6	8.7
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2	11.3	16.2	20.5	20.5	20.5	20.5	19.9	19.9	18.7	16.2	15.0	13.8	11.9	10.7	9.5	8.8	7.6

80	T=240	T=300	T=360	T=420	T=480	T=540	T=600	T=660	T=720	T=780	T=840	T=900	T=1020	T=1380
.7	14.0	12.8	11.6	10.5	9.3	8.7	8.2	7.6	7.6	7.0	7.0	7.0	7.0	7.0
.6	16.8	15.1	12.8	11.6	10.5	9.3	8.7	8.2	7.6	7.0	7.0	7.6	7.0	7.6
.6	17.9	15.6	13.9	12.2	10.4	9.3	8.7	8.1	7.6	7.0	7.0	7.0	7.0	7.0
.0	15.7	13.9	11.6	10.5	10.5	8.7	8.2	7.6	7.6	7.0	6.4	7.0	7.0	7.6
.6	18.2	15.8	12.9	11.7	10.5	9.9	8.2	8.2	7.6	7.6	7.6	7.6	7.6	7.6
.4	16.9	15.1	12.8	11.1	10.5	9.3	8.7	8.2	7.6	7.0	7.0	7.0	7.0	7.0
-	—	—	—	—	—	—	—	—	—	—	—	—	—	—
.1	1.1	2.8	4.0	4.6	5.8	6.4	6.4	7.0	7.0	7.0	7.0	7.0	7.0	7.0
.5	18.6	16.2	14.5	12.8	11.0	9.9	8.7	7.6	7.0	7.0	6.4	7.0	7.0	7.0
.6	12.1	11.5	10.4	9.8	9.2	8.7	8.1	8.1	7.6	7.6	7.6	7.0	7.6	7.6
-	—	—	—	—	—	—	—	—	—	—	—	—	—	—
.6	13.1	12.0	11.5	10.4	9.8	8.1	7.6	8.7	8.1	7.6	7.0	7.0	7.6	7.0
-	—	—	—	—	—	—	—	—	—	—	—	—	—	—
.7	16.2	15.0	13.8	11.9	10.7	9.5	8.8	7.6	7.0	7.0	7.0	7.0	7.0	7.0

(Sheet 8 of 8)

Table 3
H Pattern System Average Piezometer Reading During Filling Operation, Type 14
Normal Valve Operation

Piezometer Location			Average Piezometer Readings, Prototype Feet of Water						
No.	Station	Elevation	T=0 LC=7.0	T=15 LC=7.2	T=30 LC=8.2	T=45 LC=9.9	T=60 LC=12.7	T=75 LC=16.0	T=90 LC=19.0
1	21+17.8	-16.0	76.5	75.3	74.5	73.2	72.0	72.0	72.6
1A	21+17.8	-16.0	76.5	76.0	75.1	73.9	72.7	72.5	72.9
2	21+25.2	-16.0	76.5	76.3	75.0	73.6	73.1	73.1	73.4
2A	21+25.2	-16.0	76.5	75.7	74.9	74.6	74.5	74.6	74.5
3	21+22.9	-16.0	76.5	76.0	74.5	73.5	72.6	73.0	73.3
3A	21+22.9	-16.0	76.5	76.9	74.5	73.3	72.6	72.8	72.9
4	21+29.5	-16.0	76.5	75.6	73.7	70.7	68.3	67.6	68.6
4A	21+29.5	-16.0	76.5	75.8	73.8	70.7	67.7	67.9	68.5
5	21+39.4	-16.0	76.5	75.4	74.1	73.5	71.4	71.3	71.9
5A	21+39.4	-16.0	76.5	75.0	74.3	72.2	70.9	70.6	71.3
6	21+36.2	-16.0	76.5	75.5	73.9	71.8	70.2	71.0	70.7
6A	21+36.2	-16.0	76.5	75.5	74.0	72.6	70.1	70.1	70.8
7	21+42.5	-16.0	76.5	75.8	72.8	68.7	64.5	64.0	65.1
7A	21+42.5	-16.0	76.5	75.7	73.2	68.6	64.2	63.5	64.6
8	21+53.8	-16.0	76.5	74.4	72.4	70.3	67.2	67.1	67.7
8A	21+53.8	-16.0	76.5	75.3	73.7	66.4	68.6	68.1	68.8
9	21+49.7	-16.0	76.5	74.9	73.0	70.1	68.2	67.6	67.6
9A	21+49.7	-16.0	76.5	75.1	73.2	70.1	67.9	68.0	67.6
10	21+55.9	-16.0	76.5	74.3	73.3	67.4	62.6	61.9	62.9
10A	21+55.9	-16.0	76.5	74.8	72.8	69.4	68.4	68.2	67.8
11	21+70.0	-13.6	76.5	73.9	67.4	56.7	45.2	43.6	46.7
12	21+85.0	-17.0	76.5	70.3	63.9	53.5	43.1	41.6	43.3
13	21+91.0	-17.0	76.5	73.0	65.7	54.9	44.7	43.4	45.5
13A	21+91.0	-17.0	76.5	73.0	66.0	54.4	42.3	41.7	43.2
14	22+05.0	-17.0	76.5	72.7	65.1	53.4	41.1	42.6	42.8
14A	22+05.0	-17.0	76.5	72.0	65.7	52.0	39.3	38.1	40.2
15	22+52.1	-17.0	7.0	9.0	10.0	19.5	49.2	49.8	51.1
15A	22+52.1	-17.0	7.0	5.7	7.4	16.2	45.1	45.9	47.3
16	21+53.5	-17.0	7.0	8.7	7.7	19.6	43.0	41.5	44.9
17	22+59.1	-16.9	7.0	11.0	8.8	20.1	48.1	48.8	50.1

rage Piezometer Reading During Filling Operation, Type 14 Design, Upper Pool El 76.5 Ft, Lower Pool El 7 Ft, Lift 69.5
on

Average Piezometer Readings, Prototype Feet of Water													
T=0 LC=7.0	T=15 LC=7.2	T=30 LC=8.2	T=45 LC=9.9	T=60 LC=12.7	T=75 LC=16.0	T=90 LC=19.0	T=105 LC=22.0	T=120 LC=24.9	T=150 LC=31.2	T=180 LC=36.0	T=240 LC=45.2	T=300 LC=53.4	T=36 LC=5
76.5	75.3	74.5	73.2	72.0	72.0	72.6	72.9	73.2	73.6	73.9	74.3	75.1	75.0
76.5	76.0	75.1	73.9	72.7	72.5	72.9	73.2	73.2	73.9	74.2	74.9	75.4	76.6
76.5	76.3	75.0	73.6	73.1	73.1	73.4	74.6	74.6	74.2	74.7	75.1	75.5	75.9
76.5	75.7	74.9	74.6	74.5	74.6	74.5	75.0	75.1	75.5	75.9	75.6	75.8	76.3
76.5	76.0	74.5	73.5	72.6	73.0	73.3	73.4	73.6	73.8	74.4	75.0	75.5	75.7
76.5	76.9	74.5	73.3	72.6	72.8	72.9	73.0	73.4	73.6	74.3	75.5	75.2	75.6
76.5	75.6	73.7	70.7	68.3	67.6	68.6	69.6	70.2	70.7	71.8	72.7	74.1	75.3
76.5	75.8	73.8	70.7	67.7	67.9	68.5	68.8	69.6	70.6	71.3	72.6	73.9	74.7
76.5	75.4	74.1	73.5	71.4	71.3	71.9	72.0	72.5	72.9	73.5	74.2	75.0	76.0
76.5	75.0	74.3	72.2	70.9	70.6	71.3	71.9	71.8	72.7	73.2	74.1	74.7	75.3
76.5	75.5	73.9	71.8	70.2	71.0	70.7	71.1	71.6	72.1	73.5	73.7	74.6	75.3
76.5	75.5	74.0	72.6	70.1	70.1	70.8	71.3	71.5	71.9	73.0	73.7	75.0	75.7
76.5	75.8	72.8	68.7	64.5	64.0	65.1	65.7	66.5	67.8	69.0	71.2	72.8	74.0
76.5	75.7	73.2	68.6	64.2	63.5	64.6	65.5	65.9	67.4	69.3	70.5	73.3	73.8
76.5	74.4	72.4	70.3	67.2	67.1	67.7	68.8	68.9	70.5	70.8	72.1	73.1	74.0
76.5	75.3	73.7	66.4	68.6	68.1	68.8	69.2	69.9	70.7	71.8	73.0	74.1	76.4
76.5	74.9	73.0	70.1	68.2	67.6	67.6	70.2	68.5	69.0	69.9	72.3	74.4	74.6
76.5	75.1	73.2	70.1	67.9	68.0	67.6	68.3	68.7	69.8	70.9	72.6	74.0	74.7
76.5	74.3	73.3	67.4	62.6	61.9	62.9	63.5	64.7	66.1	67.6	70.3	72.4	73.6
76.5	74.8	72.8	69.4	68.4	68.2	67.8	68.2	69.0	68.3	68.9	70.7	72.1	73.6
76.5	73.9	67.4	56.7	45.2	43.6	46.7	47.0	49.1	52.3	56.3	62.1	66.4	70.0
76.5	70.3	63.9	53.5	43.1	41.6	43.3	44.8	46.8	51.3	53.0	59.2	64.2	67.9
76.5	73.0	65.7	54.9	44.7	43.4	45.5	47.3	48.5	52.2	55.5	61.5	66.1	69.5
76.5	73.0	66.0	54.4	42.3	41.7	43.2	42.7	46.4	50.1	53.7	60.0	65.4	69.2
76.5	72.7	65.1	53.4	41.1	42.6	42.8	44.5	46.4	50.6	53.5	59.9	65.2	68.8
76.5	72.0	65.7	52.0	39.3	38.1	40.2	41.8	43.9	48.3	51.3	58.4	64.3	67.9
7.0	9.0	10.0	19.5	49.2	49.8	51.1	53.2	54.7	58.1	61.4	67.2	68.6	69.5
7.0	5.7	7.4	16.2	45.1	45.9	47.3	49.7	50.7	54.0	56.6	61.5	65.6	68.6
7.0	8.7	7.7	19.6	43.0	41.5	44.9	44.7	47.1	50.1	52.5	58.5	63.9	67.3
7.0	11.0	8.8	20.1	48.1	48.8	50.1	51.7	53.0	55.8	58.3	62.5	66.3	69.6

. Design, Upper Pool El 76.5 Ft, Lower Pool El 7 Ft, Lift 69.5 Ft, Valve Speed 1 Min (Constant Speed Gate),

T=105 LC=22.0	T=120 LC=24.9	T=150 LC=31.2	T=180 LC=36.0	T=240 LC=45.2	T=300 LC=53.4	T=360 LC=59.9	T=420 LC=65.8	T=480 LC=69.8	T=540 LC=73.0	T=600 LC=75.3	T=660 LC=76.5
72.9	73.2	73.6	73.9	74.3	75.1	75.0	75.7	76.4	76.2	76.5	76.5
73.2	73.2	73.9	74.2	74.9	75.4	76.6	76.2	76.3	76.4	76.6	76.5
74.6	74.6	74.2	74.7	75.1	75.5	75.9	76.7	76.3	76.9	76.5	76.5
75.0	75.1	75.5	75.9	75.6	75.8	76.3	76.3	76.3	76.4	76.5	76.5
73.4	73.6	73.8	74.4	75.0	75.5	75.7	76.5	76.2	76.8	76.5	76.5
73.0	73.4	73.6	74.3	75.5	75.2	75.6	76.6	76.1	76.2	76.5	76.5
69.6	70.2	70.7	71.8	72.7	74.1	75.3	75.4	76.0	76.2	76.5	76.5
68.8	69.6	70.6	71.3	72.6	73.9	74.7	75.5	76.0	76.3	76.5	76.5
72.0	72.5	72.9	73.5	74.2	75.0	76.0	75.8	76.0	76.3	76.6	76.5
71.9	71.8	72.7	73.2	74.1	74.7	75.3	76.3	76.1	76.8	76.5	76.5
71.1	71.6	72.1	73.5	73.7	74.6	75.3	75.7	76.2	76.3	76.5	76.5
71.3	71.5	71.9	73.0	73.7	75.0	75.7	76.1	76.2	76.7	76.5	76.5
65.7	66.5	67.8	69.0	71.2	72.8	74.0	75.6	75.6	76.2	76.5	76.5
65.5	65.9	67.4	69.3	70.5	73.3	73.8	75.0	75.6	76.1	76.6	76.5
68.8	68.9	70.5	70.8	72.1	73.1	74.0	74.6	75.3	75.7	76.4	76.5
69.2	69.9	70.7	71.8	73.0	74.1	76.4	76.0	76.2	76.5	76.6	76.5
70.2	68.5	69.0	69.9	72.3	74.4	74.6	75.6	75.9	76.1	76.5	76.5
68.3	68.7	69.8	70.9	72.6	74.0	74.7	75.4	76.4	76.3	76.5	76.5
63.5	64.7	66.1	67.6	70.3	72.4	73.6	74.9	75.7	77.0	76.5	76.5
68.2	69.0	68.3	68.9	70.7	72.1	73.6	74.5	75.2	76.1	76.5	76.5
47.0	49.1	52.3	56.3	62.1	66.4	70.0	72.3	74.2	75.6	76.4	76.5
44.8	46.8	51.3	53.0	59.2	64.2	67.9	70.6	72.6	73.9	76.3	76.5
47.3	48.5	52.2	55.5	61.5	66.1	69.5	72.2	74.2	75.6	76.5	76.5
42.7	46.4	50.1	53.7	60.0	65.4	69.2	71.9	74.1	75.4	76.5	76.5
44.5	46.4	50.6	53.5	59.9	65.2	68.8	71.9	74.2	75.2	76.4	76.5
41.8	43.9	48.3	51.3	58.4	64.3	67.9	71.4	74.1	75.5	76.4	76.5
53.2	54.7	58.1	61.4	67.2	68.6	69.5	71.1	73.2	74.8	75.8	76.5
49.7	50.7	54.0	56.6	61.5	65.6	68.6	71.7	73.2	74.9	76.2	76.5
44.7	47.1	50.1	52.5	58.5	63.9	67.3	70.6	73.7	75.2	76.9	76.5
51.7	53.0	55.8	58.3	62.5	66.3	69.6	72.2	73.8	75.4	76.2	76.5

(Sheet 1 of 6)

Table 3 (Continued)

Piezometer Location									
No.	Station	Ele-vation	T=0 LC=7.0	T=15 LC=7.2	T=30 LC=8.2	T=45 LC=9.9	T=60 LC=12.7	T=75 LC=16.0
18	22+62.6	-16.8	7.0	8.7	7.7	21.2	48.7	49.6
19	22+69.1	-16.6	7.0	10.2	10.6	30.2	47.0	47.6
20	22+76.6	-16.5	7.0	11.7	16.9	35.4	52.0	53.4
21	22+90.6	-16.5	7.0	17.0	18.8	37.8	46.7	47.4
21A	22+90.6	-16.5	7.0	18.2	21.4	33.7	44.6	45.7
22	23+50.0	-16.5	7.0	17.9	28.6	37.4	45.0	46.1
23	24+50.0	-16.5	7.0	16.8	26.0	34.4	41.0	43.4
24	25+50.0	-16.5	7.0	14.9	21.5	31.0	38.9	41.7
24A	25+50.0	-16.5	7.0	15.0	21.5	31.3	38.3	41.0
25	26+04.3	-24.25	7.0	14.1	21.9	33.3	44.6	47.4
26	25+95.9	-24.25	7.0	12.6	16.6	22.3	26.5	29.3
27	26+09.2	-17.0	7.0	13.0	18.2	26.2	34.4	36.0
27A	26+09.2	-17.0	7.0	13.3	18.1	26.8	33.2	35.1
28	26+01.3	-20.1	7.0	10.4	10.2	9.5	8.4	9.6
29	26+12.4	-20.1	7.0	13.2	17.0	25.8	33.1	35.5
30	25+96.0	-20.1	7.0	10.4	10.2	10.3	9.0	9.5
31	26+04.5	-20.1	7.0	11.1	16.6	24.6	32.8	36.1
32	25+88.1	-20.1	7.0	10.1	10.3	9.6	8.5	9.7
33	25+92.6	-20.1	7.0	11.4	16.4	24.0	32.0	36.8
34	26+01.3	-28.4	7.0	10.2	11.0	11.5	10.3	11.4
35	26+12.4	-28.4	7.0	10.8	16.3	23.6	33.2	37.7
36	25+96.0	-28.4	7.0	9.2	10.3	11.1	10.8	11.4
37	26+04.1	-28.4	7.0	11.0	17.3	26.9	32.3	35.0
38	25+88.1	-28.4	7.0	9.9	10.6	11.3	9.6	10.7
39	25+92.6	-28.4	7.0	10.2	15.0	22.2	30.5	34.7
40	25+75.0	-24.1	7.0	10.4	13.8	19.4	24.6	27.2
41	25+75.0	-24.1	7.0	10.0	12.0	17.4	22.1	24.6
42	25+70.0	-24.0	7.0	9.5	12.2	14.3	17.8	20.9
43	25+70.0	-24.0	7.0	9.7	11.2	14.5	16.6	18.8
44	25+65.0	-23.1	7.0	9.2	9.6	8.8	9.5	11.6
45	25+65.0	-23.1	7.0	9.5	9.1	9.2	8.7	11.1

							Average Piezometer Readings, Prototype Feet of Water						
T=0 LC=7.0	T=15 LC=7.2	T=30 LC=8.2	T=45 LC=9.9	T=60 LC=12.7	T=75 LC=16.0	T=90 LC=19.0	T=105 LC=22.0	T=120 LC=24.9	T=150 LC=31.2	T=180 LC=36.0	T=240 LC=45.2	T=300 LC=53.4	T=360 LC=59.9
7.0	8.7	7.7	21.2	48.7	49.6	50.4	52.6	54.0	56.5	58.6	63.2	67.0	69.8
7.0	10.2	10.6	30.2	47.0	47.6	49.0	50.6	52.2	55.1	57.3	62.0	65.8	69.0
7.0	11.7	16.9	35.4	52.0	53.4	55.1	56.4	57.2	58.1	59.1	61.6	65.3	69.0
7.0	17.0	18.8	37.8	46.7	47.4	48.7	50.4	52.1	54.8	57.2	62.0	65.8	69.0
7.0	18.2	21.4	33.7	44.6	45.7	47.3	49.0	50.4	53.4	56.1	60.8	65.0	68.6
7.0	17.9	28.6	37.4	45.0	46.1	47.8	48.9	50.4	53.4	56.7	61.2	65.1	68.7
7.0	16.8	26.0	34.4	41.0	43.4	44.8	46.2	48.2	51.6	54.6	59.8	64.4	67.9
7.0	14.9	21.5	31.0	38.9	41.7	44.0	45.4	47.4	50.3	53.4	59.0	64.3	67.7
7.0	15.0	21.5	31.3	38.3	41.0	43.2	45.0	46.8	50.1	53.2	58.9	63.5	67.3
7.0	14.1	21.9	33.3	44.6	47.4	49.5	50.7	52.3	53.9	56.9	62.3	66.2	69.1
7.0	12.6	16.6	22.3	26.5	29.3	31.9	33.7	36.4	41.3	45.1	52.7	59.4	64.4
7.0	13.0	18.2	26.2	34.4	36.0	37.9	40.3	42.0	46.4	49.9	56.1	61.7	66.4
7.0	13.3	18.1	26.8	33.2	35.1	37.6	40.6	41.5	45.6	49.7	56.1	61.3	65.9
7.0	10.4	10.2	9.5	8.4	9.6	13.1	15.8	19.9	25.2	31.1	41.5	51.3	59.2
7.0	13.2	17.0	25.8	33.1	35.5	37.8	38.8	41.8	45.5	48.5	55.1	61.1	65.7
7.0	10.4	10.2	10.3	9.0	9.5	13.0	16.9	20.6	26.1	33.8	46.0	53.7	57.4
7.0	11.1	16.6	24.6	32.8	36.1	38.5	39.6	42.1	45.2	48.5	54.6	60.1	64.6
7.0	10.1	10.3	9.6	8.5	9.7	13.0	16.6	20.6	27.2	36.2	46.9	51.1	57.5
7.0	11.4	16.4	24.0	32.0	36.8	39.0	40.4	44.1	49.2	53.7	58.6	60.6	64.4
7.0	10.2	11.0	11.5	10.3	11.4	14.0	17.1	20.1	26.9	32.8	43.1	52.3	59.1
7.0	10.8	16.3	23.6	33.2	37.7	40.0	41.1	43.1	47.2	50.5	56.4	62.3	66.1
7.0	9.2	10.3	11.1	10.8	11.4	13.3	16.0	19.1	25.2	29.7	40.6	51.3	61.5
7.0	11.0	17.3	26.9	32.3	35.0	36.8	38.8	41.0	45.0	48.8	55.4	60.7	65.1
7.0	9.9	10.6	11.3	9.6	10.7	14.1	17.0	21.2	28.7	36.5	48.0	52.0	57.3
7.0	10.2	15.0	22.2	30.5	34.7	37.4	38.5	40.9	44.9	49.3	55.4	61.2	65.8
7.0	10.4	13.8	19.4	24.6	27.2	29.8	32.1	35.7	40.1	46.3	55.3	62.2	64.5
7.0	10.0	12.0	17.4	22.1	24.6	28.9	31.2	33.8	38.1	43.5	50.6	57.2	62.8
7.0	9.5	12.2	14.3	17.8	20.9	23.7	26.5	29.1	34.3	38.8	47.4	54.8	61.1
7.0	9.7	11.2	14.5	16.6	18.8	21.9	25.8	27.9	34.0	39.3	48.1	55.5	62.6
7.0	9.2	9.6	8.8	9.5	11.6	14.4	17.3	21.9	25.3	33.5	42.9	53.2	59.1
7.0	9.5	9.1	9.2	8.7	11.1	14.3	17.8	20.4	27.7	34.4	44.5	52.0	57.5

Average Piezometer Readings, Prototype Feet of Water											
=105 C=22.0	T=120 LC=24.9	T=150 LC=31.2	T=180 LC=36.0	T=240 LC=45.2	T=300 LC=53.4	T=360 LC=59.9	T=420 LC=65.8	T=480 LC=69.8	T=540 LC=73.0	T=600 LC=75.3	T=660 LC=76.5
2.6	54.0	56.5	58.6	63.2	67.0	69.8	72.1	73.9	75.2	76.0	76.5
0.6	52.2	55.1	57.3	62.0	65.8	69.0	71.7	73.7	75.2	76.0	76.5
6.4	57.2	58.1	59.1	61.6	65.3	69.0	71.3	73.7	75.2	75.9	76.5
0.4	52.1	54.8	57.2	62.0	65.8	69.0	71.7	74.1	75.2	76.1	76.5
9.0	50.4	53.4	56.1	60.8	65.0	68.6	71.3	73.5	75.3	76.2	76.5
8.9	50.4	53.4	56.7	61.2	65.1	68.7	71.5	73.3	74.7	76.0	76.5
6.2	48.2	51.6	54.6	59.8	64.4	67.9	70.8	73.0	74.8	76.2	76.5
5.4	47.4	50.3	53.4	59.0	64.3	67.7	70.7	73.2	74.7	76.2	76.5
5.0	46.8	50.1	53.2	58.9	63.5	67.3	70.5	72.8	74.8	76.0	76.5
0.7	52.3	53.9	56.9	62.3	66.2	69.1	71.6	73.8	75.1	76.1	76.5
3.7	36.4	41.3	45.1	52.7	59.4	64.4	68.6	71.9	74.4	75.8	76.5
0.3	42.0	46.4	49.9	56.1	61.7	66.4	69.8	72.4	74.4	75.9	76.5
0.6	41.5	45.6	49.7	56.1	61.3	65.9	69.8	72.3	74.5	75.9	76.5
15.8	19.9	25.2	31.1	41.5	51.3	59.2	64.6	69.7	73.2	75.4	76.5
38.8	41.8	45.5	48.5	55.1	61.1	65.7	69.1	72.3	74.4	75.6	76.5
16.9	20.6	26.1	33.8	46.0	53.7	57.4	63.6	69.0	72.4	75.2	76.5
39.6	42.1	45.2	48.5	54.6	60.1	64.6	68.5	71.7	74.1	75.6	76.5
16.6	20.6	27.2	36.2	46.9	51.1	57.5	64.1	69.1	72.7	75.2	76.5
40.4	44.1	49.2	53.7	58.6	60.6	64.4	68.3	71.5	74.0	75.6	76.5
17.1	20.1	26.9	32.8	43.1	52.3	59.1	65.0	69.3	73.2	75.1	76.5
41.1	43.1	47.2	50.5	56.4	62.3	66.1	69.3	71.9	74.0	75.3	76.5
16.0	19.1	25.2	29.7	40.6	51.3	61.5	67.1	71.4	74.8	76.4	76.5
38.8	41.0	45.0	48.8	55.4	60.7	65.1	68.8	71.8	74.2	75.5	76.5
17.0	21.2	28.7	36.5	48.0	52.0	57.3	63.4	68.4	72.2	74.9	76.5
38.5	40.9	44.9	49.3	55.4	61.2	65.8	69.4	72.2	74.3	75.6	76.5
32.1	35.7	40.1	46.3	55.3	62.2	64.5	67.9	71.0	73.4	75.1	76.5
31.2	33.8	38.1	43.5	50.6	57.2	62.8	67.6	70.6	73.7	75.6	76.5
26.5	29.1	34.3	38.8	47.4	54.8	61.1	66.2	70.3	73.4	75.2	76.5
25.8	27.9	34.0	39.3	48.1	55.5	62.6	67.7	71.6	74.1	75.8	76.5
17.3	21.9	25.3	33.5	42.9	53.2	59.1	65.2	69.7	72.9	75.0	76.5
17.8	20.4	27.7	34.4	44.5	52.0	57.5	63.4	68.6	72.1	74.8	76.5

(Sheet 2 of 6)

Table 3 (Continued)

Piezometer Location									
No.	Station	Ele-vation	T=0 LC=7.0	T=15 LC=7.2	T=30 LC=8.2	T=45 LC=9.9	T=60 LC=12.7	T=75 LC=16.0	T=90 LC=19.
46	25+65.0	-23.1	7.0	11.0	19.0	32.7	43.0	56.8	56.0
47	25+60.0	-22.7	7.0	9.4	10.4	12.6	13.0	15.5	18.4
48	25+60.0	-22.7	7.0	9.9	10.9	13.0	15.2	16.8	20.2
49	25+60.0	-22.7	7.0	9.7	10.5	11.9	12.4	14.3	17.2
50	25+60.0	-22.7	7.0	9.4	10.2	10.5	10.3	12.1	14.7
51	25+50.0	-22.1	7.0	9.2	11.4	14.7	18.7	21.2	24.6
52	25+50.0	-22.1	7.0	9.2	10.9	14.1	16.5	19.2	22.6
53	25+50.0	-22.1	7.0	9.4	10.9	14.3	16.9	20.7	23.1
54	25+50.0	-22.1	7.0	9.4	10.9	14.7	17.6	21.0	23.5
55	25+40.0	-21.5	7.0	8.8	11.8	15.7	22.4	25.8	27.3
56	25+40.0	-21.5	7.0	8.3	11.0	14.3	17.9	20.0	22.8
57	25+40.0	-21.5	7.0	9.5	11.6	15.3	18.6	21.8	24.1
58	25+40.0	-21.5	7.0	9.2	11.7	15.9	19.8	22.1	25.8
59	25+30.0	-20.9	7.0	9.0	12.6	18.6	25.1	29.0	30.2
60	25+30.0	-20.9	7.0	8.8	10.4	13.5	17.2	20.2	21.9
61	25+30.0	-20.9	7.0	9.1	10.8	13.5	17.3	19.3	21.6
62	25+30.0	-20.9	7.0	9.0	12.5	17.0	22.8	25.3	27.8
63	25+25.0	-20.9	7.0	9.1	13.1	21.0	29.5	33.7	34.9
64	25+25.0	-20.6	7.0	8.3	8.6	10.0	12.0	14.4	16.9
65	25+25.0	-20.6	7.0	8.8	8.7	9.6	9.8	11.5	14.7
66	25+25.0	-20.6	7.0	9.1	13.3	19.6	27.7	31.5	34.3
68	25+23.0	-20.6	7.0	7.3	8.2	10.3	12.9	15.9	19.0
69	25+23.0	-20.6	7.0	8.8	9.2	11.0	12.5	15.5	17.4
70	25+23.0	-20.6	7.0	9.4	12.4	18.6	25.9	29.8	32.4
71	25+10.2	-24.25	7.0	8.6	11.5	16.3	22.1	25.9	29.4
71A	25+10.2	-24.25	7.0	8.1	11.1	16.0	16.1	16.7	18.9
72	25+00.2	-24.25	7.0	8.8	12.9	19.1	25.9	30.3	32.4
73	24+90.2	-24.25	7.0	8.8	13.7	21.2	30.7	35.8	38.6
74	24+80.2	-24.25	7.0	8.4	13.7	21.9	31.9	36.7	38.9
75	24+70.2	-24.25	7.0	8.1	14.1	23.1	34.0	39.6	41.5
76	24+60.2	-24.25	7.0	7.9	14.4	24.2	35.7	41.6	43.1

	Average Piezometer Readings, Prototype Feet of Water													
	T=0 LC=7.0	T=15 LC=7.2	T=30 LC=8.2	T=45 LC=9.9	T=60 LC=12.7	T=75 LC=16.0	T=90 LC=19.0	T=105 LC=22.0	T=120 LC=24.9	T=150 LC=31.2	T=180 LC=36.0	T=240 LC=45.2	T=300 LC=53.4	T=3 LC=
	7.0	11.0	19.0	32.7	43.0	56.8	56.0	58.2	59.9	61.7	62.8	64.1	66.5	69.3
	7.0	9.4	10.4	12.6	13.0	15.5	18.4	22.2	25.6	31.1	36.0	45.9	54.0	60.7
	7.0	9.9	10.9	13.0	15.2	16.8	20.2	23.7	26.9	31.9	37.9	46.8	55.3	62.0
	7.0	9.7	10.5	11.9	12.4	14.3	17.2	20.6	23.0	29.7	35.3	45.2	53.6	60.7
	7.0	9.4	10.2	10.5	10.3	12.1	14.7	18.1	21.0	27.1	34.1	43.8	52.9	59.6
	7.0	9.2	11.4	14.7	18.7	21.2	24.6	28.1	30.4	35.5	40.3	48.8	56.5	62.2
	7.0	9.2	10.9	14.1	16.5	19.2	22.6	25.9	28.5	33.7	38.6	47.3	55.6	61.5
	7.0	9.4	10.9	14.3	16.9	20.7	23.1	26.6	29.6	35.2	41.3	48.7	53.2	60.0
	7.0	9.4	10.9	14.7	17.6	21.0	23.5	26.6	29.2	34.2	40.0	48.3	55.5	62.0
	7.0	8.8	11.8	15.7	22.4	25.8	27.3	29.9	32.5	38.0	42.5	50.8	57.3	62.8
	7.0	8.3	11.0	14.3	17.9	20.0	22.8	25.4	28.6	34.4	38.6	47.5	55.8	61.3
	7.0	9.5	11.6	15.3	18.6	21.8	24.1	28.1	30.4	35.4	40.3	49.3	56.4	62.3
	7.0	9.2	11.7	15.9	19.8	22.1	25.8	29.0	31.8	36.8	41.7	50.1	57.5	63.4
	7.0	9.0	12.6	18.6	25.1	29.0	30.2	33.6	34.4	40.4	44.5	51.7	58.7	63.5
	7.0	8.8	10.4	13.5	17.2	20.2	21.9	24.8	28.0	33.5	38.4	47.1	55.2	61.5
	7.0	9.1	10.8	13.5	17.3	19.3	21.6	25.7	28.6	33.6	39.1	47.9	55.3	61.8
	7.0	9.0	12.5	17.0	22.8	25.3	27.8	31.6	34.3	38.8	43.4	51.3	58.1	63.2
	7.0	9.1	13.1	21.0	29.5	33.7	34.9	37.1	39.8	43.3	47.3	53.7	59.6	64.5
	7.0	8.3	8.6	10.0	12.0	14.4	16.9	19.9	23.5	29.3	34.6	43.7	52.6	59.9
	7.0	8.8	8.7	9.6	9.8	11.5	14.7	18.8	21.7	28.4	34.1	44.6	53.3	60.3
	7.0	9.1	13.3	19.6	27.7	31.5	34.3	36.4	39.1	42.9	46.5	53.8	59.9	64.3
	7.0	7.3	8.2	10.3	12.9	15.9	19.0	21.9	25.1	30.8	36.1	45.3	53.6	60.1
	7.0	8.8	9.2	11.0	12.5	15.5	17.4	21.5	24.9	30.6	35.8	45.6	53.9	60.5
	7.0	9.4	12.4	18.6	25.9	29.8	32.4	34.8	37.6	41.3	45.6	52.8	59.2	64.2
5	7.0	8.6	11.5	16.3	22.1	25.9	29.4	33.5	34.8	35.6	39.5	47.8	55.7	62.
5	7.0	8.1	11.1	16.0	16.1	16.7	18.9	21.9	25.6	31.4	36.5	45.7	53.9	60.
5	7.0	8.8	12.9	19.1	25.9	30.3	32.4	34.8	37.1	42.3	46.0	53.5	59.3	64.
5	7.0	8.8	13.7	21.2	30.7	35.8	38.6	40.5	43.4	48.0	51.8	62.4	63.9	65.
5	7.0	8.4	13.7	21.9	31.9	36.7	38.9	40.7	43.0	46.9	50.5	56.2	61.6	65.
5	7.0	8.1	14.1	23.1	34.0	39.6	41.5	43.8	45.5	48.6	52.0	57.9	62.9	66.
5	7.0	7.9	14.4	24.2	35.7	41.6	43.1	45.2	47.4	50.2	53.4	58.8	63.4	67.

Average Piezometer Readings, Prototype Feet of Water												
0	T=105 LC=22.0	T=120 LC=24.9	T=150 LC=31.2	T=180 LC=36.0	T=240 LC=45.2	T=300 LC=53.4	T=360 LC=59.9	T=420 LC=65.8	T=480 LC=69.8	T=540 LC=73.0	T=600 LC=75.3	T=660 LC=76.5
	58.2	59.9	61.7	62.8	64.1	66.5	69.3	71.7	73.5	74.9	75.8	76.5
	22.2	25.6	31.1	36.0	45.9	54.0	60.7	66.0	69.8	72.8	75.1	76.5
	23.7	26.9	31.9	37.9	46.8	55.3	62.0	67.0	70.6	73.5	75.8	76.5
	20.6	23.0	29.7	35.3	45.2	53.6	60.7	65.7	70.2	73.4	75.4	76.5
	18.1	21.0	27.1	34.1	43.8	52.9	59.6	65.4	69.8	73.3	75.4	76.5
	28.1	30.4	35.5	40.3	48.8	56.5	62.2	67.3	70.7	73.7	75.6	76.5
	25.9	28.5	33.7	38.6	47.3	55.6	61.5	66.6	70.7	73.3	75.4	76.5
	26.6	29.6	35.2	41.3	48.7	53.2	60.0	65.7	69.7	72.7	75.2	76.5
	26.6	29.2	34.2	40.0	48.3	55.5	62.0	66.7	70.9	73.6	75.4	76.5
	29.9	32.5	38.0	42.5	50.8	57.3	62.8	67.5	71.0	74.1	75.6	76.5
	25.4	28.6	34.4	38.6	47.5	55.8	61.3	67.0	70.6	73.5	75.5	76.5
	28.1	30.4	35.4	40.3	49.3	56.4	62.3	67.0	70.8	74.0	75.7	76.5
	29.0	31.8	36.8	41.7	50.1	57.5	63.4	68.7	72.2	74.2	75.6	76.5
	33.6	34.4	40.4	44.5	51.7	58.7	63.5	67.8	71.5	73.9	75.6	76.5
	24.8	28.0	33.5	38.4	47.1	55.2	61.5	66.4	70.7	73.6	75.6	76.5
	25.7	28.6	33.6	39.1	47.9	55.3	61.8	66.8	70.6	73.5	75.4	76.5
	31.6	34.3	38.8	43.4	51.3	58.1	63.2	68.0	71.2	73.8	75.6	76.5
	37.1	39.8	43.3	47.3	53.7	59.6	64.5	68.3	71.6	73.9	75.5	76.5
	19.9	23.5	29.3	34.6	43.7	52.6	59.9	65.1	70.1	73.1	75.2	76.5
	18.8	21.7	28.4	34.1	44.6	53.3	60.3	65.7	70.1	73.3	75.4	76.5
	36.4	39.1	42.9	46.5	53.8	59.9	64.3	68.8	71.9	74.0	75.6	76.5
	21.9	25.1	30.8	36.1	45.3	53.6	60.1	65.8	70.1	73.1	75.4	76.5
	21.5	24.9	30.6	35.8	45.6	53.9	60.5	66.0	70.2	73.5	75.3	76.5
	34.8	37.6	41.3	45.6	52.8	59.2	64.2	68.4	71.9	74.0	75.7	76.5
	33.5	34.8	35.6	39.5	47.8	55.7	62.0	66.6	70.5	73.3	75.3	76.5
	21.9	25.6	31.4	36.5	45.7	53.9	60.5	66.0	70.1	73.5	75.1	76.5
	34.8	37.1	42.3	46.0	53.5	59.3	64.7	68.6	72.1	74.2	75.9	76.5
	40.5	43.4	48.0	51.8	62.4	63.9	65.9	68.8	71.6	74.1	75.5	76.5
	40.7	43.0	46.9	50.5	56.2	61.6	65.7	69.1	72.0	74.2	75.4	76.5
	43.8	45.5	48.6	52.0	57.9	62.9	66.8	70.0	72.9	74.5	75.9	76.5
	45.2	47.4	50.2	53.4	58.8	63.4	67.2	70.4	72.8	74.6	76.0	76.5

(Sheet 3 of 6)

Table 3 (Continued)

Piezometer Location									
No.	Station	Ele-vation	T=0 LC=7.0	T=15 LC=7.2	T=30 LC=8.2	T=45 LC=9.9	T=60 LC=12.7	T=75 LC=16.0	T=90 LC=19.
77	24+50.2	-24.25	7.0	7.1	9.4	13.0	23.0	34.3	37.5
78	24+40.2	-24.25	7.0	7.6	14.4	24.7	36.8	43.0	45.4
79	24+30.2	-24.25	7.0	7.3	14.1	24.8	37.9	43.9	46.4
79A	24+30.2	-24.25	7.0	7.7	14.5	25.2	39.0	44.5	45.9
80	26+17.0	-28.4	7.0	10.5	10.7	11.6	11.8	11.7	15.6
81	26+06.0	-28.4	7.0	11.8	16.6	24.7	33.0	34.2	37.5
82	26+22.4	-28.4	7.0	10.4	10.4	11.6	12.2	11.9	15.7
83	26+13.9	-28.4	7.0	11.4	16.0	24.1	32.3	34.2	37.0
84	26+30.3	-28.4	7.0	10.1	10.0	10.8	9.6	11.9	14.7
85	26+25.7	-28.4	7.0	11.1	15.4	23.6	31.0	33.7	35.3
86	26+17.0	-20.1	7.0	10.8	10.5	10.6	8.3	7.9	12.1
87	26+06.0	-20.1	7.0	11.2	16.0	24.4	32.2	34.9	37.7
88	26+22.4	-20.1	7.0	10.2	10.0	9.8	8.6	8.1	12.1
89	26+13.9	-20.1	7.0	11.3	16.0	24.2	33.5	35.7	38.3
90	26+30.3	-20.1	7.0	10.3	9.9	9.3	8.5	7.6	12.0
91	26+25.7	-20.1	7.0	10.9	15.5	22.6	31.3	34.6	37.7
92	26+43.3	-24.1	7.0	10.5	13.2	19.3	25.0	28.3	30.7
93	26+43.3	-24.1	7.0	10.4	13.7	18.7	25.0	26.8	29.8
94	26+48.3	-24.0	7.0	10.1	11.6	14.8	17.4	18.7	21.8
95	26+48.3	-24.0	7.0	10.2	11.9	14.6	18.9	21.7	23.6
96	26+53.3	-23.1	7.0	9.1	9.4	8.8	8.4	8.2	11.3
97	26+53.3	-23.1	7.0	9.5	8.2	6.4	4.6	4.9	9.2
98	26+53.3	-23.1	7.0	11.1	17.2	30.4	45.8	48.9	51.8
99	26+58.3	-22.7	7.0	10.0	11.0	12.8	13.4	14.5	18.3
100	26+58.3	-22.7	7.0	9.9	11.1	12.6	13.4	15.9	18.1
101	26+58.3	-22.7	7.0	10.0	10.9	12.2	12.3	14.9	17.0
102	26+58.3	-22.7	7.0	9.6	10.3	11.5	12.3	14.1	17.4
103	26+68.3	-22.1	7.0	9.6	11.4	14.9	18.7	21.5	23.5
104	26+68.3	-22.1	7.0	9.2	11.2	14.7	17.6	20.6	23.0
105	26+68.3	-22.1	7.0	9.8	11.2	14.0	15.9	19.2	21.1
106	26+68.3	-22.1	7.0	9.8	11.5	15.3	18.1	20.9	23.7

							Average Piezometer Readings, Prototype Feet of Water						
T=0 LC=7.0	T=15 LC=7.2	T=30 LC=8.2	T=45 LC=9.9	T=60 LC=12.7	T=75 LC=16.0	T=90 LC=19.0	T=105 LC=22.0	T=120 LC=24.9	T=150 LC=31.2	T=180 LC=36.0	T=240 LC=45.2	T=300 LC=53.4	T=360 LC=59.
7.0	7.1	9.4	13.0	23.0	34.3	37.5	39.3	41.7	45.3	49.8	55.1	60.7	65.1
7.0	7.6	14.4	24.7	36.8	43.0	45.4	47.1	49.5	52.0	55.0	59.7	64.0	67.8
7.0	7.3	14.1	24.8	37.9	43.9	46.4	47.4	48.5	51.3	54.0	59.5	63.9	67.7
7.0	7.7	14.5	25.2	39.0	44.5	45.9	48.5	49.7	52.2	55.7	60.6	64.3	67.8
7.0	10.5	10.7	11.6	11.8	11.7	15.6	18.6	20.5	28.5	33.3	42.9	52.9	60.3
7.0	11.8	16.6	24.7	33.0	34.2	37.5	39.7	40.9	45.4	49.2	55.7	61.7	66.9
7.0	10.4	10.4	11.6	12.2	11.9	15.7	18.2	21.5	27.7	33.6	43.7	52.9	60.3
7.0	11.4	16.0	24.1	32.3	34.2	37.0	37.9	40.4	44.6	48.6	54.5	60.4	65.6
7.0	10.1	10.0	10.8	9.6	11.9	14.7	17.5	21.1	26.6	33.3	43.3	52.7	59.6
7.0	11.1	15.4	23.6	31.0	33.7	35.3	38.1	40.5	43.5	47.4	54.4	61.0	65.2
7.0	10.8	10.5	10.6	8.3	7.9	12.1	14.3	19.0	26.0	31.6	41.5	51.5	59.4
7.0	11.2	16.0	24.4	32.2	34.9	37.7	38.6	42.2	46.3	49.7	55.4	61.2	65.9
7.0	10.2	10.0	9.8	8.6	8.1	12.1	14.6	18.6	26.0	31.4	41.9	51.5	58.7
7.0	11.3	16.0	24.2	33.5	35.7	38.3	39.1	42.6	46.5	49.9	56.1	61.7	66.5
7.0	10.3	9.9	9.3	8.5	7.6	12.0	14.5	17.9	25.5	31.1	42.2	51.5	58.8
7.0	10.9	15.5	22.6	31.3	34.6	37.7	38.4	40.5	45.7	48.9	54.8	61.7	65.4
7.0	10.5	13.2	19.3	25.0	28.3	30.7	31.6	35.7	39.3	43.9	50.9	58.5	63.8
7.0	10.4	13.7	18.7	25.0	26.8	29.8	32.4	34.7	39.1	44.7	50.9	58.0	63.8
7.0	10.1	11.6	14.8	17.4	18.7	21.8	24.4	27.6	32.9	37.9	47.3	55.1	61.1
7.0	10.2	11.9	14.6	18.9	21.7	23.6	25.8	29.2	34.9	39.3	47.4	55.4	61.7
7.0	9.1	9.4	8.8	8.4	8.2	11.3	14.2	16.0	21.5	25.8	39.2	45.6	57.1
7.0	9.5	8.2	6.4	4.6	4.9	9.2	12.1	16.3	23.3	29.9	40.1	50.1	57.8
7.0	11.1	17.2	30.4	45.8	48.9	51.8	56.0	55.9	57.3	58.5	61.7	67.5	70.3
7.0	10.0	11.0	12.8	13.4	14.5	18.3	22.5	25.1	31.7	36.2	47.4	56.6	63.9
7.0	9.9	11.1	12.6	13.4	15.9	18.1	21.9	25.4	30.5	36.6	46.0	53.5	60.4
7.0	10.0	10.9	12.2	12.3	14.9	17.0	20.9	24.3	30.2	36.0	45.8	54.1	61.0
7.0	9.6	10.3	11.5	12.3	14.1	17.4	20.1	23.9	30.4	36.0	45.7	54.1	60.8
7.0	9.6	11.4	14.9	18.7	21.5	23.5	27.2	28.8	35.0	40.2	50.6	57.9	61.1
7.0	9.2	11.2	14.7	17.6	20.6	23.0	26.4	28.4	33.8	39.2	48.0	55.7	61.7
7.0	9.8	11.2	14.0	15.9	19.2	21.1	24.5	27.8	33.1	38.1	47.1	54.8	61.4
7.0	9.8	11.5	15.3	18.1	20.9	23.7	27.1	30.3	36.2	41.0	48.9	56.2	61.1

Average Piezometer Readings, Prototype Feet of Water

T=105 LC=22.0	T=120 LC=24.9	T=150 LC=31.2	T=180 LC=36.0	T=240 LC=45.2	T=300 LC=53.4	T=360 LC=59.9	T=420 LC=65.8	T=480 LC=69.8	T=540 LC=73.0	T=600 LC=75.3	T=660 LC=76.5
39.3	41.7	45.3	49.8	55.1	60.7	65.1	68.8	72.0	74.0	75.6	76.5
47.1	49.5	52.0	55.0	59.7	64.0	67.8	70.9	73.3	74.7	75.7	76.5
47.4	48.5	51.3	54.0	59.5	63.9	67.7	70.5	73.2	75.1	76.0	76.5
48.5	49.7	52.2	55.7	60.6	64.3	67.8	71.0	73.1	74.9	76.2	76.5
18.6	20.5	28.5	33.3	42.9	52.9	60.3	65.8	70.3	73.4	75.1	76.5
39.7	40.9	45.4	49.2	55.7	61.7	66.9	70.6	73.0	74.4	75.7	76.5
18.2	21.5	27.7	33.6	43.7	52.9	60.3	65.7	70.2	73.5	75.4	76.5
37.9	40.4	44.6	48.6	54.5	60.4	65.6	69.7	72.1	74.5	75.7	76.5
17.5	21.1	26.6	33.3	43.3	52.7	59.6	64.9	70.0	73.1	75.2	76.5
38.1	40.5	43.5	47.4	54.4	61.0	65.2	68.9	72.4	74.1	76.0	76.5
14.3	19.0	26.0	31.6	41.5	51.5	59.4	64.8	69.6	73.2	75.5	76.5
38.6	42.2	46.3	49.7	55.4	61.2	65.9	69.5	72.0	74.4	75.8	76.5
14.6	18.6	26.0	31.4	41.9	51.5	58.7	64.9	69.9	73.3	75.3	76.5
39.1	42.6	46.5	49.9	56.1	61.7	66.5	69.9	72.4	74.4	76.0	76.5
14.5	17.9	25.5	31.1	42.2	51.5	58.8	64.9	69.9	73.1	75.6	76.5
38.4	40.5	45.7	48.9	54.8	61.7	65.4	69.7	72.2	74.4	75.7	76.5
31.6	35.7	39.3	43.9	50.9	58.5	63.8	67.7	71.7	74.0	75.7	76.5
32.4	34.7	39.1	44.7	50.9	58.0	63.8	68.1	71.5	74.0	76.0	76.5
24.4	27.6	32.9	37.9	47.3	55.1	61.1	66.5	70.5	73.5	75.2	76.5
25.8	29.2	34.9	39.3	47.4	55.4	61.7	66.7	70.9	73.5	75.3	76.5
14.2	16.0	21.5	25.8	39.2	45.6	57.1	61.4	71.3	73.7	75.5	76.5
12.1	16.3	23.3	29.9	40.1	50.1	57.8	64.7	69.6	73.0	75.3	76.5
56.0	55.9	57.3	58.5	61.7	67.5	70.3	72.7	74.5	75.5	76.2	76.5
22.5	25.1	31.7	36.2	47.4	56.6	63.9	69.9	72.7	74.1	75.7	76.5
21.9	25.4	30.5	36.6	46.0	53.5	60.4	66.0	70.1	73.1	75.2	76.5
20.9	24.3	30.2	36.0	45.8	54.1	61.0	66.8	71.5	74.8	76.4	76.5
20.1	23.9	30.4	36.0	45.7	54.1	60.8	66.2	70.5	73.2	75.6	76.5
27.2	28.8	35.0	40.2	50.6	57.9	61.1	65.9	70.4	73.2	75.4	76.5
26.4	28.4	33.8	39.2	48.0	55.7	61.7	66.9	71.1	73.8	75.7	76.5
24.5	27.8	33.1	38.1	47.1	54.8	61.4	66.6	70.4	73.3	75.4	76.5
27.1	30.3	36.2	41.0	48.9	56.2	61.1	65.0	69.4	72.6	75.3	76.5

(Sheet 4 of 6)

Table 3 (Continued)

Piezometer Location										
No.	Station	Elevation	T=0 LC=7.0	T=15 LC=7.2	T=30 LC=8.2	T=45 LC=9.9	T=60 LC=12.7	T=75 LC=16.0	T=90 LC=19.0
107	26+78.3	-21.5	7.0	9.2	12.0	15.9	20.6	23.9	26.3
108	26+78.3	-21.5	7.0	8.9	11.5	14.8	19.0	22.1	24.9
109	26+78.3	-21.5	7.0	9.4	11.2	15.1	18.6	21.3	23.1
110	26+78.3	-21.5	7.0	9.4	11.4	15.1	19.4	23.1	25.6
111	26+88.3	-20.9	7.0	9.1	12.1	16.9	23.8	27.3	29.7
112	26+88.3	-20.9	7.0	9.1	10.8	13.4	17.2	19.0	22.2
113	26+88.3	-20.9	7.0	8.8	10.2	12.7	15.7	18.8	22.0
114	26+88.3	-20.9	7.0	9.3	12.5	18.4	26.1	30.2	32.1
115	26+93.3	-20.6	7.0	9.5	13.3	20.2	27.5	32.5	34.7
116	26+93.3	-20.6	7.0	8.8	9.2	10.2	12.0	13.7	17.0
117	26+93.3	-20.6	7.0	8.2	8.2	8.4	8.9	11.5	14.8
118	26+93.3	-20.6	7.0	9.2	12.6	19.2	26.7	31.2	33.5
119	26+95.3	-20.6	7.0	7.2	8.0	12.9	20.1	26.2	28.5
120	26+95.3	-20.6	7.0	8.7	9.7	11.7	13.2	15.6	19.1
121	26+95.3	-20.6	7.0	8.0	8.5	9.7	10.9	13.6	17.0
122	26+95.3	-20.6	7.0	8.8	12.3	19.4	26.2	29.0	32.0
123	27+08.1	-24.25	7.0	8.8	12.2	17.9	23.8	26.1	29.8
123A	27+08.1	-24.25	7.0	9.2	12.3	17.7	23.2	27.1	29.0
124	27+18.1	-24.25	7.0	8.4	12.5	18.8	25.8	29.1	32.1
125	27+28.1	-24.25	7.0	8.3	13.1	20.7	28.8	33.1	35.6
126	27+38.1	-24.25	7.0	8.3	13.4	21.5	31.3	35.6	37.8
127	27+48.1	-24.25	7.0	8.0	13.5	22.3	33.1	38.2	40.1
128	27+58.1	-24.25	7.0	8.0	13.8	23.5	35.1	40.2	41.7
129	27+68.1	-24.25	7.0	7.7	13.9	23.9	36.5	41.7	42.9
130	27+78.1	-24.25	7.0	7.9	14.2	24.5	37.3	42.9	44.2
131	27+88.1	-24.25	7.0	7.6	14.4	25.0	38.6	44.1	45.5
131A	27+88.1	-24.25	7.0	7.6	14.7	25.0	37.3	42.6	44.9
132	26+14.0	-24.25	7.0	13.2	21.1	30.7	42.6	46.9	47.9
133	26+22.5	-24.25	7.0	13.1	21.1	30.9	41.5	46.2	47.6
134	26+70.0	-17.0	7.0	13.5	20.7	32.4	43.1	47.3	48.6
134A	26+70.0	-17.0	7.0	14.5	21.0	32.8	43.4	46.8	48.6

Average Piezometer Readings, Prototype Feet of Water													
T=0 LC=7.0	T=15 LC=7.2	T=30 LC=8.2	T=45 LC=9.9	T=60 LC=12.7	T=75 LC=16.0	T=90 LC=19.0	T=105 LC=22.0	T=120 LC=24.9	T=150 LC=31.2	T=180 LC=36.0	T=240 LC=45.2	T=300 LC=53.4	T=3 LC=
7.0	9.2	12.0	15.9	20.6	23.9	26.3	29.0	31.2	36.3	41.2	49.7	56.8	62.7
7.0	8.9	11.5	14.8	19.0	22.1	24.9	27.7	30.3	35.8	40.4	49.0	56.3	62.4
7.0	9.4	11.2	15.1	18.6	21.3	23.1	26.9	30.2	34.9	39.7	48.4	55.7	61.7
7.0	9.4	11.4	15.1	19.4	23.1	25.6	28.6	30.9	36.3	41.9	51.4	59.1	64.7
7.0	9.1	12.1	16.9	23.8	27.3	29.7	32.7	34.7	39.4	44.2	51.5	58.1	63.2
7.0	9.1	10.8	13.4	17.2	19.0	22.2	25.7	28.8	34.2	39.1	45.7	51.0	65.9
7.0	8.8	10.2	12.7	15.7	18.8	22.0	24.1	27.1	32.6	38.3	46.9	54.7	61.3
7.0	9.3	12.5	18.4	26.1	30.2	32.1	35.1	37.0	42.3	47.3	54.0	57.8	62.1
7.0	9.5	13.3	20.2	27.5	32.5	34.7	37.0	39.8	43.1	47.6	53.7	60.0	64.9
7.0	8.8	9.2	10.2	12.0	13.7	17.0	20.2	23.7	29.3	35.1	45.6	54.0	60.7
7.0	8.2	8.2	8.4	8.9	11.5	14.8	16.6	20.6	26.9	32.6	43.0	52.0	59.1
7.0	9.2	12.6	19.2	26.7	31.2	33.5	34.9	38.0	42.6	45.8	53.0	59.2	64.3
7.0	7.2	8.0	12.9	20.1	26.2	28.5	30.9	34.2	38.0	42.9	49.9	57.1	62.5
7.0	8.7	9.7	11.7	13.2	15.6	19.1	22.6	26.2	32.1	37.7	47.5	56.6	64.0
7.0	8.0	8.5	9.7	10.9	13.6	17.0	20.6	23.9	29.5	35.4	45.5	53.6	60.7
7.0	8.8	12.3	19.4	26.2	29.0	32.0	34.8	36.9	40.7	44.8	53.2	59.1	64.3
7.0	8.8	12.2	17.9	23.8	26.1	29.8	31.9	35.0	38.9	43.3	51.0	57.8	63.3
7.0	9.2	12.3	17.7	23.2	27.1	29.0	31.8	34.5	39.1	43.8	51.2	57.9	63.2
7.0	8.4	12.5	18.8	25.8	29.1	32.1	34.5	36.7	40.8	45.1	52.3	58.8	63.8
7.0	8.3	13.1	20.7	28.8	33.1	35.6	37.6	39.8	43.7	47.6	54.4	60.2	65.0
7.0	8.3	13.4	21.5	31.3	35.6	37.8	39.8	41.7	45.7	49.1	55.3	61.0	65.4
7.0	8.0	13.5	22.3	33.1	38.2	40.1	42.2	43.7	47.3	50.6	56.5	61.8	66.2
7.0	8.0	13.8	23.5	35.1	40.2	41.7	43.7	44.9	49.0	51.9	57.3	62.3	66.3
7.0	7.7	13.9	23.9	36.5	41.7	42.9	45.1	46.6	49.7	53.0	58.3	63.3	67.1
7.0	7.9	14.2	24.5	37.3	42.9	44.2	46.4	47.5	51.2	53.9	59.1	63.5	67.2
7.0	7.6	14.4	25.0	38.6	44.1	45.5	47.3	49.4	52.1	55.3	60.0	64.2	67.7
7.0	7.6	14.7	25.0	37.3	42.6	44.9	47.1	48.2	51.7	55.2	59.7	63.7	67.6
7.0	13.2	21.1	30.7	42.6	46.9	47.9	49.9	51.8	55.0	57.0	61.4	65.6	68.8
7.0	13.1	21.1	30.9	41.5	46.2	47.6	49.4	51.7	53.7	55.8	61.2	65.0	68.3
7.0	13.5	20.7	32.4	43.1	47.3	48.6	50.1	51.8	54.5	56.7	61.5	65.6	68.7
7.0	14.5	21.0	32.8	43.4	46.8	48.6	50.5	51.5	54.3	56.9	61.6	65.3	68.4

Average Piezometer Readings, Prototype Feet of Water

T=105 LC=22.0	T=120 LC=24.9	T=150 LC=31.2	T=180 LC=36.0	T=240 LC=45.2	T=300 LC=53.4	T=360 LC=59.9	T=420 LC=65.8	T=480 LC=69.8	T=540 LC=73.0	T=600 LC=75.3	T=660 LC=76.5
29.0	31.2	36.3	41.2	49.7	56.8	62.7	67.4	71.2	74.0	76.0	76.5
27.7	30.3	35.8	40.4	49.0	56.3	62.4	67.1	70.8	73.6	75.4	76.5
26.9	30.2	34.9	39.7	48.4	55.7	61.7	66.7	70.7	73.5	75.4	76.5
28.6	30.9	36.3	41.9	51.4	59.1	64.7	67.4	69.2	72.7	75.1	76.5
32.7	34.7	39.4	44.2	51.5	58.1	63.2	67.7	71.1	74.0	75.8	76.5
25.7	28.8	34.2	39.1	45.7	51.0	65.9	69.6	72.4	74.4	75.9	76.5
24.1	27.1	32.6	38.3	46.9	54.7	61.3	66.5	70.6	73.4	75.8	76.5
35.1	37.0	42.3	47.3	54.0	57.8	62.1	67.2	70.8	73.7	75.3	76.5
37.0	39.8	43.1	47.6	53.7	60.0	64.9	68.7	71.7	74.3	75.8	76.5
20.2	23.7	29.3	35.1	45.6	54.0	60.7	66.2	70.5	73.6	75.5	76.5
16.6	20.6	26.9	32.6	43.0	52.0	59.1	65.2	69.6	73.0	75.3	76.5
34.9	38.0	42.6	45.8	53.0	59.2	64.3	68.3	71.6	74.3	75.5	76.5
30.9	34.2	38.0	42.9	49.9	57.1	62.5	67.3	70.9	73.5	75.1	76.5
22.6	26.2	32.1	37.7	47.5	56.6	64.0	69.4	70.0	72.6	75.2	76.5
20.6	23.9	29.5	35.4	45.5	53.6	60.7	66.0	70.0	73.0	75.3	76.5
34.8	36.9	40.7	44.8	53.2	59.1	64.3	68.2	71.3	74.1	75.7	76.5
31.9	35.0	38.9	43.3	51.0	57.8	63.3	68.4	71.2	73.9	75.4	76.5
31.8	34.5	39.1	43.8	51.2	57.9	63.2	67.7	71.1	73.6	75.4	76.5
34.5	36.7	40.8	45.1	52.3	58.8	63.8	68.1	71.5	74.0	75.6	76.5
37.6	39.8	43.7	47.6	54.4	60.2	65.0	68.8	72.4	74.6	76.0	76.5
39.8	41.7	45.7	49.1	55.3	61.0	65.4	69.5	72.1	74.2	75.7	76.5
42.2	43.7	47.3	50.6	56.5	61.8	66.2	69.5	72.2	74.4	75.7	76.5
43.7	44.9	49.0	51.9	57.3	62.3	66.3	69.8	72.2	74.3	75.5	76.5
45.1	46.6	49.7	53.0	58.3	63.3	67.1	70.2	72.5	74.7	75.9	76.5
46.4	47.5	51.2	53.9	59.1	63.5	67.2	70.1	72.7	74.8	75.7	76.5
47.3	49.4	52.1	55.3	60.0	64.2	67.7	70.5	72.7	74.9	75.8	76.5
47.1	48.2	51.7	55.2	59.7	63.7	67.6	70.6	73.3	75.2	76.0	76.5
49.9	51.8	55.0	57.0	61.4	65.6	68.8	71.2	73.3	74.7	76.1	76.5
49.4	51.7	53.7	55.8	61.2	65.0	68.3	71.0	73.5	74.9	75.8	76.5
50.1	51.8	54.5	56.7	61.5	65.6	68.7	71.0	73.4	74.9	75.8	76.5
50.5	51.5	54.3	56.9	61.6	65.3	68.4	71.4	73.3	74.8	75.8	76.5

(Sheet 5 of 6)

Table 3 (Concluded)

Piezometer Location										
No.	Station	Elevation	T=0 LC=7.0	T=15 LC=7.2	T=30 LC=8.2	T=45 LC=9.9	T=60 LC=12.7	T=75 LC=16.0	T= LC
135	27+85.0	-17.0	7.0	14.3	20.8	33.1	44.4	48.3	50
135A	27+85.0	-17.0	7.0	16.1	20.5	33.2	43.5	47.4	48
136	28+60.0	-18.0	7.0	14.3	20.1	32.6	43.6	47.3	48
136A	28+60.0	-18.0	7.0	16.9	20.1	33.6	43.8	47.5	48
137	28+72.0	-18.0	7.0	14.9	20.2	32.8	44.1	47.6	49
137A	28+72.0	-18.0	7.0	17.2	19.9	33.9	43.8	47.4	48
161	22+57.6	-24.0	7.0	6.2	5.9	16.8	50.7	51.4	53
162	22+57.6	-26.4	7.0	7.1	7.7	20.6	47.9	48.7	50
163	22+60.6	-24.0	7.0	4.9	5.9	18.1	49.8	50.9	52
164	22+60.6	-26.4	7.0	5.9	6.7	22.4	50.2	51.1	51

	Average Piezometer Readings, Prototype Feet of Water													
n	T=0 LC=7.0	T=15 LC=7.2	T=30 LC=8.2	T=45 LC=9.9	T=60 LC=12.7	T=75 LC=16.0	T=90 LC=19.0	T=105 LC=22.0	T=120 LC=24.9	T=150 LC=31.2	T=180 LC=36.0	T=240 LC=45.2	T=300 LC=53.4	T: L(
0	7.0	14.3	20.8	33.1	44.4	48.3	50.0	51.8	53.3	56.7	58.7	63.2	67.0	69
0	7.0	16.1	20.5	33.2	43.5	47.4	48.5	50.4	51.4	54.6	57.2	61.8	65.7	68
0	7.0	14.3	20.1	32.6	43.6	47.3	48.5	50.4	51.6	54.7	57.1	61.7	65.6	68
0	7.0	16.9	20.1	33.6	43.8	47.5	48.6	50.6	51.6	54.6	57.2	61.7	65.4	68
0	7.0	14.9	20.2	32.8	44.1	47.6	49.2	50.7	52.0	55.3	57.7	62.1	66.2	68
0	7.0	17.2	19.9	33.9	43.8	47.4	48.5	50.7	51.7	54.6	57.2	61.9	65.7	68
0	7.0	6.2	5.9	16.8	50.7	51.4	53.4	55.2	57.0	60.4	62.4	64.2	66.2	68
4	7.0	7.1	7.7	20.6	47.9	48.7	50.1	51.6	53.0	55.6	58.2	62.6	66.3	69
0	7.0	4.9	5.9	18.1	49.8	50.9	52.5	54.1	55.6	58.6	61.6	66.8	72.6	75
4	7.0	5.9	6.7	22.4	50.2	51.1	51.9	53.2	54.3	55.6	57.5	62.1	65.7	68

Average Piezometer Readings, Prototype Feet of Water											
T=105 LC=22.0	T=120 LC=24.9	T=150 LC=31.2	T=180 LC=36.0	T=240 LC=45.2	T=300 LC=53.4	T=360 LC=59.9	T=420 LC=65.8	T=480 LC=69.8	T=540 LC=73.0	T=600 LC=75.3	T=660 LC=76.5
51.8	53.3	56.7	58.7	63.2	67.0	69.7	72.1	74.1	75.1	76.2	76.5
50.4	51.4	54.6	57.2	61.8	65.7	68.9	71.4	73.4	74.8	75.9	76.5
50.4	51.6	54.7	57.1	61.7	65.6	68.9	71.5	73.5	75.1	75.8	76.5
50.6	51.6	54.6	57.2	61.7	65.4	68.8	71.4	73.2	74.7	76.0	76.5
50.7	52.0	55.3	57.7	62.1	66.2	68.8	71.6	73.7	74.9	75.9	76.5
50.7	51.7	54.6	57.2	61.9	65.7	68.8	71.5	73.4	75.0	76.2	76.5
55.2	57.0	60.4	62.4	64.2	66.2	68.5	71.0	73.4	74.3	75.9	76.5
51.6	53.0	55.6	58.2	62.6	66.3	69.5	72.0	74.0	75.3	76.2	76.5
54.1	55.6	58.6	61.6	66.8	72.6	75.2	76.0	76.2	76.4	76.4	76.5
53.2	54.3	55.6	57.5	62.1	65.7	68.8	71.5	73.5	74.9	76.0	76.5

(Sheet 6 of 6)

Table 4
H Pattern System Average Piezometer Reading During Emptying Operation, Type 14 Design, Upper Pc

Piezometer Location											
No.	Station	Ele-vation	T=0 LC=76.5	T=15 LC=76.3	T=30 LC=75.5	T=45 LC=74.0	T=60 LC=72.0	T=75 LC=69.5	T=90 LC=67.4	T=105 LC=65.1	T=120 LC=63.
15	22+52.1	-17.0	76.5	74.5	68.4	54.5	44.0	42.7	40.7	39.5	37.3
15A	22+52.1	-17.0	76.5	70.1	64.4	53.6	45.0	43.2	40.9	38.8	38.0
16	21+53.5	-17.0	76.5	69.3	62.8	50.9	41.5	40.1	38.6	37.4	35.4
17	22+59.1	-16.9	76.5	69.7	63.4	52.1	43.2	41.1	39.2	37.7	35.9
18	22+62.6	-16.8	76.5	69.0	62.7	50.8	41.3	40.0	38.8	37.7	34.9
19	22+69.1	-16.6	76.5	68.7	62.4	50.7	41.6	39.9	37.3	36.8	36.0
20	22+76.6	-16.5	76.5	68.8	63.4	59.2	47.9	45.3	43.1	42.1	40.1
21	22+90.6	-16.5	76.5	69.0	62.9	51.6	42.1	40.3	37.8	37.7	35.8
21A	22+90.6	-16.5	76.5	69.3	63.4	52.4	45.1	42.2	40.2	38.2	37.0
22	23+50.0	-16.5	76.5	68.7	62.9	51.3	41.7	40.0	37.5	37.1	35.7
23	24+50.0	-16.5	76.5	68.6	62.7	53.3	45.3	43.9	41.8	39.7	38.8
24	25+50.0	-16.5	76.5	68.7	62.7	50.7	41.3	40.6	38.6	36.9	36.6
24A	25+50.0	-16.5	76.5	68.8	63.2	52.1	43.2	41.5	39.6	37.3	36.2
25	26+04.3	-24.25	76.5	68.7	62.0	49.9	37.5	38.7	36.1	35.1	34.8
26	25+95.9	-24.25	76.5	68.4	62.2	49.8	39.5	38.3	36.5	35.9	35.1
27	26+09.2	-17.0	76.5	68.9	60.7	47.0	36.1	33.2	32.2	30.5	30.2
27A	26+09.2	-17.0	76.5	69.5	61.5	49.0	37.3	34.7	33.6	31.9	30.4
28	26+01.3	-20.1	76.5	70.2	58.7	41.2	26.2	22.4	21.3	20.0	19.5
29	26+12.4	-20.1	76.5	72.4	68.0	55.1	43.5	40.0	38.6	36.4	35.2
30	25+96.0	-20.1	76.5	75.9	75.5	44.7	28.4	24.9	22.6	21.2	20.7
31	26+04.5	-20.1	76.5	72.1	64.9	53.4	42.9	39.5	37.9	36.4	35.3
32	25+88.1	-20.1	76.5	74.9	74.3	45.4	28.7	24.6	22.1	21.2	20.5
33	25+92.6	-20.1	76.5	75.2	74.7	55.4	44.2	41.0	38.7	37.2	35.6
34	26+01.3	-28.4	76.5	71.6	60.7	46.1	29.6	24.5	23.0	22.5	22.3
35	26+12.4	-28.4	76.5	72.2	64.6	54.0	43.1	38.8	37.5	36.5	35.4
36	25+96.0	-28.4	76.5	75.2	72.7	51.0	33.5	28.2	26.6	26.4	25.4
37	26+04.1	-28.4	76.5	72.1	64.3	54.5	51.8	50.7	46.7	45.7	38.1
38	25+88.1	-28.4	76.5	76.0	74.6	50.5	32.5	26.3	25.5	24.4	23.7
39	25+92.6	-28.4	76.5	72.5	65.2	53.8	42.5	38.8	36.9	35.7	35.2
40	25+75.0	-24.1	76.5	74.5	70.3	55.9	44.2	40.7	38.4	37.7	35.6

zometer Reading During Emptying Operation, Type 14 Design, Upper Pool El 76.5 Ft, Lower Pool El 7 Ft, Lift 69.5 Ft, Valve Speed 1 Min (C

						Average Piezometer Readings, Prototype Feet of Water								
T=15 LC=76.3	T=30 LC=75.5	T=45 LC=74.0	T=60 LC=72.0	T=75 LC=69.5	T=90 LC=67.4	T=105 LC=65.1	T=120 LC=63.1	T=150 LC=58.5	T=180 LC=54.7	T=240 LC=46.6	T=300 LC=39.5	T=360 LC=32.7	T=420 LC=27.5	T=480 LC=22.3
74.5	68.4	54.5	44.0	42.7	40.7	39.5	37.3	35.8	34.0	29.6	25.6	22.4	20.3	16.9
70.1	64.4	53.6	45.0	43.2	40.9	38.8	38.0	35.8	33.4	29.5	25.0	21.4	18.8	15.9
69.3	62.8	50.9	41.5	40.1	38.6	37.4	35.4	33.1	32.4	27.6	22.9	21.0	18.0	15.7
69.7	63.4	52.1	43.2	41.1	39.2	37.7	35.9	33.9	31.9	28.0	23.9	21.7	18.4	15.1
69.0	62.7	50.8	41.3	40.0	38.8	37.7	34.9	33.1	31.9	27.6	24.5	21.1	17.7	15.1
68.7	62.4	50.7	41.6	39.9	37.3	36.8	36.0	32.9	31.5	28.0	24.1	20.5	17.5	15.1
68.8	63.4	59.2	47.9	45.3	43.1	42.1	40.1	37.1	35.3	31.0	26.6	23.1	18.8	16.1
69.0	62.9	51.6	42.1	40.3	37.8	37.7	35.8	33.2	31.6	28.2	24.3	21.3	17.7	15.1
69.3	63.4	52.4	45.1	42.2	40.2	38.2	37.0	34.9	32.5	29.0	24.8	21.0	18.4	15.7
68.7	62.9	51.3	41.7	40.0	37.5	37.1	35.7	33.0	31.0	28.0	24.3	21.1	18.1	15.4
68.6	62.7	53.3	45.3	43.9	41.8	39.7	38.8	35.6	33.0	29.3	25.3	21.8	18.5	15.4
68.7	62.7	50.7	41.3	40.6	38.6	36.9	36.6	32.9	32.9	27.1	24.1	20.9	18.1	15.2
68.8	63.2	52.1	43.2	41.5	39.6	37.3	36.2	35.1	32.8	28.4	25.1	20.6	18.2	15.6
68.7	62.0	49.9	37.5	38.7	36.1	35.1	34.8	32.2	32.2	26.5	24.7	20.3	18.1	14.9
68.4	62.2	49.8	39.5	38.3	36.5	35.9	35.1	31.4	30.3	26.2	23.4	20.2	18.0	15.2
68.9	60.7	47.0	36.1	33.2	32.2	30.5	30.2	28.1	26.7	23.4	21.2	18.4	16.1	14.3
69.5	61.5	49.0	37.3	34.7	33.6	31.9	30.4	29.7	27.6	24.4	20.7	18.1	16.1	13.7
70.2	58.7	41.2	26.2	22.4	21.3	20.0	19.5	19.2	18.7	16.6	15.2	14.0	12.4	11.4
72.4	68.0	55.1	43.5	40.0	38.6	36.4	35.2	33.5	31.6	27.2	23.7	20.8	17.8	15.2
75.9	75.5	44.7	28.4	24.9	22.6	21.2	20.7	20.4	19.4	17.6	16.2	14.8	13.0	11.7
72.1	64.9	53.4	42.9	39.5	37.9	36.4	35.3	33.0	31.1	27.1	23.5	20.6	17.5	15.2
74.9	74.3	45.4	28.7	24.6	22.1	21.2	20.5	20.0	18.9	17.4	15.8	14.1	12.7	11.5
75.2	74.7	55.4	44.2	41.0	38.7	37.2	35.6	33.9	31.4	27.8	24.3	21.0	17.8	15.4
71.6	60.7	46.1	29.6	24.5	23.0	22.5	22.3	20.8	20.2	18.1	16.3	14.6	13.0	11.8
72.2	64.6	54.0	43.1	38.8	37.5	36.5	35.4	33.3	30.8	27.2	23.9	20.4	17.4	15.1
75.2	72.7	51.0	33.5	28.2	26.6	26.4	25.4	25.0	23.2	21.4	19.5	17.0	15.3	13.9
72.1	64.3	54.5	51.8	50.7	46.7	45.7	38.1	35.5	32.7	28.2	24.6	20.6	18.0	15.7
76.0	74.6	50.5	32.5	26.3	25.5	24.4	23.7	22.8	21.4	19.2	17.3	15.7	13.7	12.4
72.5	65.2	53.8	42.5	38.8	36.9	35.7	35.2	32.9	30.8	26.9	23.4	20.2	17.3	15.0
74.5	70.3	55.9	44.2	40.7	38.4	37.7	35.6	33.8	32.0	28.0	24.3	20.9	18.0	15.4

Pool El 76.5 Ft, Lower Pool El 7 Ft, Lift 69.5 Ft, Valve Speed 1 Min (Constant Speed Gate), Normal Valve Operation

Average Piezometer Readings, Prototype Feet of Water

0 3.1	T=150 LC=58.5	T=180 LC=54.7	T=240 LC=46.6	T=300 LC=39.5	T=360 LC=32.7	T=420 LC=27.5	T=480 LC=22.3	T=540 LC=18.1	T=600 LC=14.5	T=660 LC=11.9	T=720 LC=9.3	T=780 LC=7.9	T=840 LC=7.0
	35.8	34.0	29.6	25.6	22.4	20.3	16.9	14.6	11.8	10.5	9.3	7.8	7.0
	35.8	33.4	29.5	25.0	21.4	18.8	15.9	13.4	11.8	10.3	8.8	7.8	7.0
	33.1	32.4	27.6	22.9	21.0	18.0	15.7	13.3	11.5	9.8	8.8	6.7	7.0
	33.9	31.9	28.0	23.9	21.7	18.4	15.1	13.3	11.5	9.6	8.1	7.4	7.0
	33.1	31.9	27.6	24.5	21.1	17.7	15.1	12.7	11.7	9.6	7.9	7.0	7.0
	32.9	31.5	28.0	24.1	20.5	17.5	15.1	13.4	11.4	9.3	8.0	7.3	7.0
	37.1	35.3	31.0	26.6	23.1	18.8	16.1	14.3	11.3	10.5	8.5	7.5	7.0
	33.2	31.6	28.2	24.3	21.3	17.7	15.1	13.2	10.9	9.7	8.0	7.2	7.0
	34.9	32.5	29.0	24.8	21.0	18.4	15.7	13.3	11.2	9.9	8.8	7.5	7.0
	33.0	31.0	28.0	24.3	21.1	18.1	15.4	13.0	11.2	9.6	8.5	7.5	7.0
	35.6	33.0	29.3	25.3	21.8	18.5	15.4	13.2	11.1	9.5	8.3	7.1	7.0
	32.9	32.9	27.1	24.1	20.9	18.1	15.2	12.8	11.0	9.3	8.4	7.4	7.0
	35.1	32.8	28.4	25.1	20.6	18.2	15.6	12.9	11.1	9.8	8.5	7.4	7.0
	32.2	32.2	26.5	24.7	20.3	18.1	14.9	12.7	11.4	9.7	8.6	7.7	7.0
	31.4	30.3	26.2	23.4	20.2	18.0	15.2	12.9	11.4	9.8	8.6	7.9	7.0
	28.1	26.7	23.4	21.2	18.4	16.1	14.3	12.2	10.6	9.2	8.4	7.6	7.0
	29.7	27.6	24.4	20.7	18.1	16.1	13.7	12.2	10.5	9.1	8.0	7.3	7.0
	19.2	18.7	16.6	15.2	14.0	12.4	11.4	10.3	9.3	8.6	7.8	7.3	7.0
	33.5	31.6	27.2	23.7	20.8	17.8	15.2	12.8	10.9	9.4	8.5	7.4	7.0
	20.4	19.4	17.6	16.2	14.8	13.0	11.7	10.8	9.5	8.9	8.1	7.2	7.0
	33.0	31.1	27.1	23.5	20.6	17.5	15.2	12.9	11.2	9.6	8.5	7.5	7.0
	20.0	18.9	17.4	15.8	14.1	12.7	11.5	10.5	9.6	8.4	7.7	7.5	7.0
	33.9	31.4	27.8	24.3	21.0	17.8	15.4	13.3	11.3	9.9	8.5	7.6	7.0
	20.8	20.2	18.1	16.3	14.6	13.0	11.8	10.4	9.5	8.6	7.8	7.3	7.0
	33.3	30.8	27.2	23.9	20.4	17.4	15.1	12.9	11.1	9.7	8.2	7.8	7.0
	25.0	23.2	21.4	19.5	17.0	15.3	13.9	12.8	10.3	9.0	8.5	7.7	7.0
	35.5	32.7	28.2	24.6	20.6	18.0	15.7	13.3	11.4	9.7	8.6	7.5	7.0
	22.8	21.4	19.2	17.3	15.7	13.7	12.4	11.0	9.8	8.7	8.2	7.5	7.0
	32.9	30.8	26.9	23.4	20.2	17.3	15.0	12.8	10.8	9.5	8.5	7.3	7.0
	33.8	32.0	28.0	24.3	20.9	18.0	15.4	13.2	11.1	9.5	8.4	7.4	7.0

(Sheet 1 of 6)

Table 4 (Continued)												
Piezometer Location												
No.	Station	Elevation	T=0 LC=76.5	T=15 LC=76.3	T=30 LC=75.5	T=45 LC=74.0	T=60 LC=72.0	T=75 LC=69.5	T=90 LC=67.4	T=105 LC=65.1	T= LC
41	25+75.0	-24.1	76.5	72.0	64.1	53.0	42.3	38.0	36.7	35.7	34.
42	25+70.0	-24.0	76.5	73.5	66.0	58.1	41.6	37.3	35.1	33.7	32.
43	25+70.0	-24.0	76.5	72.6	63.5	50.1	37.1	33.6	32.2	30.9	29.
44	25+65.0	-23.1	76.5	71.7	60.7	45.2	28.0	27.7	26.2	25.4	23.
45	25+65.0	-23.1	76.5	75.8	75.1	74.0	38.9	34.6	33.1	32.2	30.
46	25+65.0	-23.1	76.5	75.7	75.3	58.6	45.1	41.4	39.4	37.9	36.
47	25+60.0	-22.7	76.5	74.1	64.0	50.2	36.9	32.3	30.8	29.9	28.
48	25+60.0	-22.7	76.5	73.3	64.8	53.1	39.6	35.7	33.8	32.9	31.
49	25+60.0	-22.7	76.5	72.6	63.6	51.0	38.8	34.5	33.1	31.9	31.
50	25+60.0	-22.7	76.5	72.8	63.0	49.9	36.8	32.8	31.8	29.9	29.
51	25+50.0	-22.1	76.5	73.3	64.5	52.0	39.3	34.9	33.4	32.5	31.
52	25+50.0	-22.1	76.5	72.5	64.2	51.4	39.0	35.2	33.3	32.4	31.
53	25+50.0	-22.1	76.5	75.9	74.5	55.9	41.9	37.3	35.3	34.0	33.
54	25+50.0	-22.1	76.5	73.6	64.7	53.0	42.0	38.2	36.1	35.0	34.
55	25+40.0	-21.5	76.5	73.7	64.5	52.6	39.7	35.4	34.2	33.1	31.
56	25+40.0	-21.5	76.5	74.8	70.5	64.7	58.8	55.4	53.8	51.9	49.
57	25+40.0	-21.5	76.5	73.8	65.5	54.6	43.4	39.4	37.5	36.7	34.
58	25+40.0	-21.5	76.5	76.3	68.5	55.2	43.9	39.4	37.8	36.1	34.
59	25+30.0	-20.9	76.5	74.1	67.1	57.9	48.3	44.7	43.2	41.5	39.
60	25+30.0	-20.9	76.5	73.9	66.2	56.7	46.8	42.9	41.5	40.2	38.
61	25+30.0	-20.9	76.5	74.0	64.2	52.1	42.8	38.7	37.4	34.9	33.
62	25+30.0	-20.9	76.5	74.0	66.3	56.5	47.5	43.7	41.9	40.8	39.
63	25+25.0	-20.9	76.5	73.8	66.3	56.9	46.5	45.0	44.0	42.1	39.
64	25+25.0	-20.6	76.5	74.8	67.2	57.1	46.3	41.8	40.5	38.4	36.
65	25+25.0	-20.6	76.5	74.4	64.0	48.3	38.6	33.9	32.7	31.4	30.
66	25+25.0	-20.6	76.5	74.2	67.4	59.6	52.3	48.4	46.3	44.6	43.
68	25+23.0	-20.6	76.5	76.6	75.0	72.8	70.0	67.5	65.3	63.2	60.
69	25+23.0	-20.6	76.5	73.2	62.4	47.1	34.6	28.0	27.3	27.2	26.
70	25+23.0	-20.6	76.5	73.6	65.8	54.6	46.0	41.1	38.7	36.7	37.
71	25+10.2	-24.25	76.5	75.2	68.9	60.8	52.2	47.3	45.3	43.3	41.
71A	25+10.2	-24.25	76.5	75.7	71.9	62.9	45.4	41.9	40.5	37.0	35.

								Average Piezometer Readings, Prototype Feet of Water						
T=15 LC=76.3	T=30 LC=75.5	T=45 LC=74.0	T=60 LC=72.0	T=75 LC=69.5	T=90 LC=67.4	T=105 LC=65.1	T=120 LC=63.1	T=150 LC=58.5	T=180 LC=54.7	T=240 LC=46.6	T=300 LC=39.5	T=360 LC=32.7	T=420 LC=27.5	T=480 LC=22.3
72.0	64.1	53.0	42.3	38.0	36.7	35.7	34.3	32.4	30.4	26.7	23.0	19.9	17.2	15.1
73.5	66.0	58.1	41.6	37.3	35.1	33.7	32.0	30.7	28.8	25.2	22.2	19.2	16.8	14.3
72.6	63.5	50.1	37.1	33.6	32.2	30.9	29.5	27.8	26.7	24.1	21.2	18.0	15.9	14.0
71.7	60.7	45.2	28.0	27.7	26.2	25.4	23.9	23.7	22.4	19.8	18.5	15.6	13.4	12.3
75.8	75.1	74.0	38.9	34.6	33.1	32.2	30.9	29.8	28.0	24.5	21.3	18.9	16.2	13.8
75.7	75.3	58.6	45.1	41.4	39.4	37.9	36.4	34.7	32.4	28.0	24.5	21.0	18.1	15.4
74.1	64.0	50.2	36.9	32.3	30.8	29.9	28.6	27.1	25.6	22.6	20.2	17.7	15.4	13.5
73.3	64.8	53.1	39.6	35.7	33.8	32.9	31.6	29.8	28.0	24.7	21.7	19.3	16.7	14.4
72.6	63.6	51.0	38.8	34.5	33.1	31.9	31.0	29.5	27.7	24.0	21.3	18.8	16.4	14.1
72.8	63.0	49.9	36.8	32.8	31.8	29.9	29.9	27.8	27.1	23.1	20.4	17.4	15.7	13.8
73.3	64.5	52.0	39.3	34.9	33.4	32.5	31.6	30.0	27.7	24.9	22.1	18.7	16.3	14.6
72.5	64.2	51.4	39.0	35.2	33.3	32.4	31.2	29.9	28.0	25.0	21.7	18.9	16.7	14.4
75.9	74.5	55.9	41.9	37.3	35.3	34.0	33.4	31.4	29.2	26.0	22.6	19.4	17.1	14.6
73.6	64.7	53.0	42.0	38.2	36.1	35.0	34.2	32.5	30.2	26.6	23.3	20.3	17.3	14.8
73.7	64.5	52.6	39.7	35.4	34.2	33.1	31.2	29.7	28.0	24.9	22.0	18.9	16.4	14.6
74.8	70.5	64.7	58.8	55.4	53.8	51.9	49.7	47.1	42.9	37.3	32.2	27.2	22.5	18.8
73.8	65.5	54.6	43.4	39.4	37.5	36.7	34.8	33.2	30.8	27.9	24.4	20.5	18.1	15.0
76.3	68.5	55.2	43.9	39.4	37.8	36.1	34.9	33.4	30.6	27.3	23.6	20.1	17.4	14.9
74.1	67.1	57.9	48.3	44.7	43.2	41.5	39.4	37.2	35.1	31.3	26.9	23.3	19.6	16.5
73.9	66.2	56.7	46.8	42.9	41.5	40.2	38.5	36.1	33.8	28.9	25.5	21.9	18.7	15.5
74.0	64.2	52.1	42.8	38.7	37.4	34.9	33.9	32.4	30.2	26.9	22.8	20.0	17.0	14.7
74.0	66.3	56.5	47.5	43.7	41.9	40.8	39.1	36.6	34.5	30.2	25.8	22.3	18.5	16.2
73.8	66.3	56.9	46.5	45.0	44.0	42.1	39.5	36.2	34.2	30.2	25.3	21.9	19.0	15.4
74.8	67.2	57.1	46.3	41.8	40.5	38.4	36.9	34.9	32.3	28.4	24.7	21.0	17.9	15.3
74.4	64.0	48.3	38.6	33.9	32.7	31.4	30.3	28.0	27.6	24.4	19.9	16.8	13.4	12.6
74.2	67.4	59.6	52.3	48.4	46.3	44.6	43.5	40.3	38.4	32.8	27.8	23.7	19.9	16.7
76.6	75.0	72.8	70.0	67.5	65.3	63.2	60.8	56.4	52.7	45.1	38.3	32.1	26.6	21.7
73.2	62.4	47.1	34.6	28.0	27.3	27.2	26.0	23.9	23.1	20.7	19.1	16.2	14.2	12.2
73.6	65.8	54.6	46.0	41.1	38.7	36.7	37.4	34.3	31.7	28.3	24.1	20.8	17.9	15.6
75.2	68.9	60.8	52.2	47.3	45.3	43.3	41.5	39.2	36.3	34.7	33.0	27.5	23.1	19.1
75.7	71.9	62.9	45.4	41.9	40.5	37.0	35.7	33.0	30.4	24.9	21.2	17.6	13.5	13.0

=120 C=63.1	T=150 LC=58.5	T=180 LC=54.7	T=240 LC=46.6	T=300 LC=39.5	T=360 LC=32.7	T=420 LC=27.5	T=480 LC=22.3	T=540 LC=18.1	T=600 LC=14.5	T=660 LC=11.9	T=720 LC=9.3	T=780 LC=7.9	T=840 LC=7.0
4.3	32.4	30.4	26.7	23.0	19.9	17.2	15.1	12.9	11.1	9.6	8.7	7.5	7.0
2.0	30.7	28.8	25.2	22.2	19.2	16.8	14.3	12.5	10.8	9.6	8.6	7.6	7.0
9.5	27.8	26.7	24.1	21.2	18.0	15.9	14.0	12.2	10.6	8.9	8.1	7.4	7.0
3.9	23.7	22.4	19.8	18.5	15.6	13.4	12.3	10.6	9.4	8.4	7.4	6.8	7.0
0.9	29.8	28.0	24.5	21.3	18.9	16.2	13.8	11.8	11.0	9.1	8.4	7.5	7.0
6.4	34.7	32.4	28.0	24.5	21.0	18.1	15.4	13.2	11.3	9.7	8.3	7.5	7.0
8.6	27.1	25.6	22.6	20.2	17.7	15.4	13.5	11.6	10.6	9.4	8.1	7.7	7.0
1.6	29.8	28.0	24.7	21.7	19.3	16.7	14.4	12.4	10.9	9.1	8.0	7.4	7.0
1.0	29.5	27.7	24.0	21.3	18.8	16.4	14.1	11.9	10.3	9.2	8.3	7.3	7.0
9.9	27.8	27.1	23.1	20.4	17.4	15.7	13.8	12.1	10.4	9.3	8.4	7.6	7.0
1.6	30.0	27.7	24.9	22.1	18.7	16.3	14.6	12.4	10.9	9.5	8.3	7.5	7.0
.2	29.9	28.0	25.0	21.7	18.9	16.7	14.4	12.5	10.8	9.2	8.1	7.5	7.0
3.4	31.4	29.2	26.0	22.6	19.4	17.1	14.6	12.7	11.1	9.7	8.4	7.7	7.0
4.2	32.5	30.2	26.6	23.3	20.3	17.3	14.8	12.9	11.1	9.7	8.4	7.6	7.0
1.2	29.7	28.0	24.9	22.0	18.9	16.4	14.6	12.5	10.8	9.5	8.6	7.6	7.0
9.7	47.1	42.9	37.3	32.2	27.2	22.5	18.8	15.8	12.9	10.9	9.4	7.9	7.0
4.8	33.2	30.8	27.9	24.4	20.5	18.1	15.0	13.3	11.3	9.6	8.5	7.6	7.0
4.9	33.4	30.6	27.3	23.6	20.1	17.4	14.9	12.6	10.9	9.5	8.4	7.6	7.0
9.4	37.2	35.1	31.3	26.9	23.3	19.6	16.5	14.2	12.2	10.3	8.9	7.8	7.0
3.5	36.1	33.8	28.9	25.5	21.9	18.7	15.5	13.0	11.2	9.7	8.4	7.7	7.0
3.9	32.4	30.2	26.9	22.8	20.0	17.0	14.7	12.8	11.7	9.5	8.5	7.7	7.0
.1	36.6	34.5	30.2	25.8	22.3	18.5	16.2	13.4	11.8	9.9	8.6	7.6	7.0
9.5	36.2	34.2	30.2	25.3	21.9	19.0	15.4	13.4	11.2	9.5	8.4	7.4	7.0
5.9	34.9	32.3	28.4	24.7	21.0	17.9	15.3	12.8	11.3	9.6	8.2	7.1	7.0
0.3	28.0	27.6	24.4	19.9	16.8	13.4	12.6	10.8	9.9	8.9	8.2	7.7	7.0
3.5	40.3	38.4	32.8	27.8	23.7	19.9	16.7	13.9	11.8	10.3	8.5	7.7	7.0
0.8	56.4	52.7	45.1	38.3	32.1	26.6	21.7	17.8	14.4	11.6	9.4	7.9	7.0
5.0	23.9	23.1	20.7	19.1	16.2	14.2	12.2	11.4	9.5	9.0	7.9	7.4	7.0
7.4	34.3	31.7	28.3	24.1	20.8	17.9	15.6	13.8	11.5	9.8	8.7	7.7	7.0
.5	39.2	36.3	34.7	33.0	27.5	23.1	19.1	16.0	12.7	10.6	9.1	7.7	7.0
5.7	33.0	30.4	24.9	21.2	17.6	13.5	13.0	12.5	12.3	7.4	7.1	7.2	7.0

Average Piezometer Readings, Prototype Feet of Water

(Sheet 2 of 6)

Table 4 (Continued)

Piezometer Location												
No.	Station	Ele-vation	T=0 LC=76.5	T=15 LC=76.3	T=30 LC=75.5	T=45 LC=74.0	T=60 LC=72.0	T=75 LC=69.5	T=90 LC=67.4	T=105 LC=65.1	T=1 LC=
72	25+00.2	-24.25	76.5	75.3	69.8	62.5	54.8	51.0	49.4	48.9	46.3
73	24+90.2	-24.25	76.5	76.2	74.5	73.1	62.3	58.8	55.4	53.7	51.1
74	24+80.2	-24.25	76.5	76.0	71.8	67.1	60.8	58.1	55.1	53.2	52.0
75	24+70.2	-24.25	76.5	76.0	72.3	66.8	62.1	59.8	57.6	54.7	53.1
76	24+60.2	-24.25	76.5	76.2	72.7	68.1	63.8	61.2	58.5	55.4	54.1
77	24+50.2	-24.25	76.5	76.1	75.4	74.1	72.7	71.1	64.6	57.9	56.9
78	24+40.2	-24.25	76.5	76.3	73.4	70.3	65.8	62.7	61.2	58.5	56.9
79	24+30.2	-24.25	76.5	76.4	73.8	70.4	65.5	63.3	60.1	58.3	56.4
79A	24+30.2	-24.25	76.5	76.3	73.7	69.6	64.9	61.4	60.0	58.0	55.5
80	26+17.0	-28.4	76.5	70.1	60.3	44.7	31.7	28.8	26.8	25.8	25.1
81	26+06.0	-28.4	76.5	75.1	69.2	57.8	47.0	43.7	38.9	37.0	36.1
82	26+22.4	-28.4	76.5	70.2	59.6	44.4	31.5	27.8	26.7	25.1	23.9
83	26+13.9	-28.4	76.5	70.9	63.4	52.3	42.9	40.0	38.4	36.4	35.8
84	26+30.3	-28.4	76.5	70.6	60.4	44.8	31.4	27.9	26.1	25.0	24.6
85	26+25.7	-28.4	76.5	71.3	63.9	52.5	43.2	40.2	38.4	36.4	35.5
86	26+17.0	-20.1	76.5	71.3	60.2	45.0	29.1	25.2	23.7	23.0	22.3
87	26+06.0	-20.1	76.5	71.7	64.1	53.4	42.6	40.2	38.2	37.1	35.5
88	26+22.4	-20.1	76.5	71.6	60.2	45.2	30.1	25.2	24.0	22.8	22.3
89	26+13.9	-20.1	76.5	71.7	64.3	53.1	43.7	40.0	38.1	37.1	35.
90	26+30.3	-20.1	76.5	71.9	60.4	45.0	29.9	24.8	23.9	22.6	22.
91	26+25.7	-20.1	76.5	72.1	64.7	53.4	44.0	40.0	38.7	37.0	35.
92	26+43.3	-24.1	76.5	72.8	65.1	54.2	43.7	40.4	38.3	36.9	35.
93	26+43.3	-24.1	76.5	72.3	64.5	53.7	43.8	40.5	38.4	36.9	35.
94	26+48.3	-24.0	76.5	72.3	63.3	50.7	39.2	35.4	33.4	32.6	31.
95	26+48.3	-24.0	76.5	72.1	63.4	51.5	40.4	37.0	35.3	33.9	32.
96	26+53.3	-23.1	76.5	74.7	68.4	57.4	42.3	34.9	33.9	32.7	31.
97	26+53.3	-23.1	76.5	72.0	61.6	47.6	34.7	30.6	29.1	28.2	27.
98	26+53.3	-23.1	76.5	74.9	67.0	55.0	44.7	41.3	39.0	37.3	36.
99	26+58.3	-22.7	76.5	75.8	67.8	54.1	41.6	37.9	36.3	35.2	33.
100	26+58.3	-22.7	76.5	72.6	63.7	51.4	39.6	36.2	34.2	32.9	32.
101	26+58.3	-22.7	76.5	72.3	63.1	50.6	39.0	35.6	34.1	32.7	32.

Average Piezometer Readings, Prototype Feet of Water														
T=15 LC=76.3	T=30 LC=75.5	T=45 LC=74.0	T=60 LC=72.0	T=75 LC=69.5	T=90 LC=67.4	T=105 LC=65.1	T=120 LC=63.1	T=150 LC=58.5	T=180 LC=54.7	T=240 LC=46.6	T=300 LC=39.5	T=360 LC=32.7	T=420 LC=27.5	T=480 LC=2
75.3	69.8	62.5	54.8	51.0	49.4	48.9	46.3	43.0	41.6	35.5	30.4	25.9	21.7	17.9
76.2	74.5	73.1	62.3	58.8	55.4	53.7	51.1	47.6	45.0	38.0	33.8	27.9	22.9	19.5
76.0	71.8	67.1	60.8	58.1	55.1	53.2	52.0	49.0	44.6	38.4	33.2	28.3	23.1	19.2
76.0	72.3	66.8	62.1	59.8	57.6	54.7	53.1	50.3	46.6	39.6	34.0	28.6	24.0	19.9
76.2	72.7	68.1	63.8	61.2	58.5	55.4	54.1	50.5	47.7	40.8	34.5	29.4	24.3	19.8
76.1	75.4	74.1	72.7	71.1	64.6	57.9	56.9	56.2	54.4	45.9	38.1	36.3	23.2	21.7
76.3	73.4	70.3	65.8	62.7	61.2	58.5	56.9	53.0	49.5	42.3	36.2	30.3	25.2	21.0
76.4	73.8	70.4	65.5	63.3	60.1	58.3	56.4	53.5	50.7	46.8	43.0	37.4	30.5	24.5
76.3	73.7	69.6	64.9	61.4	60.0	58.0	55.5	51.7	48.8	41.5	34.9	29.9	25.1	20.2
70.1	60.3	44.7	31.7	28.8	26.8	25.8	25.1	23.2	22.8	20.3	17.9	15.8	14.5	12.5
75.1	69.2	57.8	47.0	43.7	38.9	37.0	36.1	33.5	32.1	28.2	24.1	20.6	18.0	15.4
70.2	59.6	44.4	31.5	27.8	26.7	25.1	23.9	22.9	22.4	20.2	18.1	16.0	14.1	12.4
70.9	63.4	52.3	42.9	40.0	38.4	36.4	35.8	33.4	31.5	27.5	24.0	20.6	17.8	15.3
70.6	60.4	44.8	31.4	27.9	26.1	25.0	24.6	22.6	22.6	20.1	18.6	16.2	14.2	12.7
71.3	63.9	52.5	43.2	40.2	38.4	36.4	35.5	33.0	31.6	27.7	24.2	20.6	17.9	15.3
71.3	60.2	45.0	29.1	25.2	23.7	23.0	22.3	21.4	20.4	18.5	16.4	14.8	13.2	12.1
71.7	64.1	53.4	42.6	40.2	38.2	37.1	35.5	34.1	32.0	27.7	23.6	20.9	17.5	15.3
71.6	60.2	45.2	30.1	25.2	24.0	22.8	22.3	21.5	20.6	18.3	16.3	14.9	13.2	11.8
71.7	64.3	53.1	43.7	40.0	38.1	37.1	35.8	34.0	32.0	27.8	23.4	20.7	17.6	15.2
71.9	60.4	45.0	29.9	24.8	23.9	22.6	22.0	21.2	19.9	17.9	15.8	14.4	12.8	11.7
72.1	64.7	53.4	44.0	40.0	38.7	37.0	35.9	34.1	31.7	27.7	23.7	20.7	17.6	15.5
72.8	65.1	54.2	43.7	40.4	38.3	36.9	35.5	33.4	31.5	27.7	23.7	20.6	18.2	15.5
72.3	64.5	53.7	43.8	40.5	38.4	36.9	35.8	33.6	32.2	28.0	24.3	20.9	18.0	15.2
72.3	63.3	50.7	39.2	35.4	33.4	32.6	31.1	29.8	28.2	24.8	21.6	19.1	16.4	14.2
72.1	63.4	51.5	40.4	37.0	35.3	33.9	32.6	30.6	29.0	25.8	22.1	19.5	16.9	14.6
74.7	68.4	57.4	42.3	34.9	33.9	32.7	31.8	31.1	29.4	27.9	21.6	19.7	17.9	17.2
72.0	61.6	47.6	34.7	30.6	29.1	28.2	27.2	25.8	24.3	22.1	19.2	17.3	15.4	13.0
74.9	67.0	55.0	44.7	41.3	39.0	37.3	36.1	34.1	32.1	28.1	23.8	20.9	18.1	15.3
75.8	67.8	54.1	41.6	37.9	36.3	35.2	33.5	31.6	29.7	26.8	23.2	19.9	17.5	15.2
72.6	63.7	51.4	39.6	36.2	34.2	32.9	32.1	30.7	29.1	25.2	22.0	19.6	16.9	14.6
72.3	63.1	50.6	39.0	35.6	34.1	32.7	32.0	29.9	28.2	25.2	21.6	19.0	16.8	14.5

Average Piezometer Readings, Prototype Feet of Water

.1	T=150 LC=58.5	T=180 LC=54.7	T=240 LC=46.6	T=300 LC=39.5	T=360 LC=32.7	T=420 LC=27.5	T=480 LC=22.3	T=540 LC=18.1	T=600 LC=14.5	T=660 LC=11.9	T=720 LC=9.3	T=780 LC=7.9	T=840 LC=7.0
	43.0	41.6	35.5	30.4	25.9	21.7	17.9	15.4	12.3	10.5	9.1	7.9	7.0
	47.6	45.0	38.0	33.8	27.9	22.9	19.5	16.2	13.4	10.7	9.1	7.9	7.0
	49.0	44.6	38.4	33.2	28.3	23.1	19.2	16.3	13.2	10.7	9.2	8.0	7.0
	50.3	46.6	39.6	34.0	28.6	24.0	19.9	16.6	13.2	10.7	9.3	7.8	7.0
	50.5	47.7	40.8	34.5	29.4	24.3	19.8	16.6	13.6	10.9	9.2	8.0	7.0
	56.2	54.4	45.9	38.1	36.3	23.2	21.7	21.1	14.1	8.0	7.4	6.6	7.0
	53.0	49.5	42.3	36.2	30.3	25.2	21.0	16.8	13.9	11.1	9.5	7.8	7.0
	53.5	50.7	46.8	43.0	37.4	30.5	24.5	17.5	14.1	11.4	8.9	7.9	7.0
	51.7	48.8	41.5	34.9	29.9	25.1	20.2	16.5	13.6	11.1	9.3	7.7	7.0
	23.2	22.8	20.3	17.9	15.8	14.5	12.5	11.2	9.8	8.9	8.1	7.3	7.0
	33.5	32.1	28.2	24.1	20.6	18.0	15.4	12.9	11.2	9.7	8.5	7.5	7.0
	22.9	22.4	20.2	18.1	16.0	14.1	12.4	11.0	9.8	8.8	7.7	7.3	7.0
	33.4	31.5	27.5	24.0	20.6	17.8	15.3	13.1	11.1	9.8	8.6	7.5	7.0
	22.6	22.6	20.1	18.6	16.2	14.2	12.7	11.4	9.5	8.7	8.2	7.4	7.0
	33.0	31.6	27.7	24.2	20.6	17.9	15.3	13.0	11.3	9.5	8.4	7.5	7.0
	21.4	20.4	18.5	16.4	14.8	13.2	12.1	10.9	9.7	8.9	8.0	7.6	7.0
	34.1	32.0	27.7	23.6	20.9	17.5	15.3	12.9	11.2	9.9	8.5	7.7	7.0
	21.5	20.6	18.3	16.3	14.9	13.2	11.8	10.9	9.7	8.6	7.8	7.3	7.0
	34.0	32.0	27.8	23.4	20.7	17.6	15.2	13.1	11.1	9.7	8.5	7.6	7.0
	21.2	19.9	17.9	15.8	14.4	12.8	11.7	10.3	9.0	8.2	7.6	7.0	7.0
	34.1	31.7	27.7	23.7	20.7	17.6	15.5	13.1	11.1	9.7	8.3	7.4	7.0
	33.4	31.5	27.7	23.7	20.6	18.2	15.5	12.9	11.3	9.7	8.5	7.4	7.0
	33.6	32.2	28.0	24.3	20.9	18.0	15.2	13.1	11.2	9.6	8.5	7.7	7.0
	29.8	28.2	24.8	21.6	19.1	16.4	14.2	12.3	10.6	9.6	8.5	7.6	7.0
	30.6	29.0	25.8	22.1	19.5	16.9	14.6	12.6	10.8	9.4	8.3	7.6	7.0
	31.1	29.4	27.9	21.6	19.7	17.9	17.2	15.7	14.4	13.8	8.2	7.4	7.0
	25.8	24.3	22.1	19.2	17.3	15.4	13.0	11.7	10.2	9.3	8.1	7.7	7.0
	34.1	32.1	28.1	23.8	20.9	18.1	15.3	13.2	11.5	9.7	8.5	8.0	7.0
	31.6	29.7	26.8	23.2	19.9	17.5	15.2	13.0	11.2	9.6	8.6	7.9	7.0
	30.7	29.1	25.2	22.0	19.6	16.9	14.6	12.9	11.0	9.5	8.6	7.6	7.0
	29.9	28.2	25.2	21.6	19.0	16.8	14.5	12.6	10.9	9.7	8.2	7.7	7.0

(Sheet 3 of 6)

Table 4 (Continued)

Piezometer Location											
No.	Station	Ele-vation	T=0 LC=76.5	T=15 LC=76.3	T=30 LC=75.5	T=45 LC=74.0	T=60 LC=72.0	T=75 LC=69.5	T=90 LC=67.4	T=105 LC=65.1	T=12 LC=6
102	26+58.3	-22.7	76.5	73.6	64.9	52.0	39.7	36.0	34.3	33.1	32.2
103	26+68.3	-22.1	76.5	74.6	70.8	55.7	42.6	39.6	37.6	35.4	34.2
104	26+68.3	-22.1	76.5	72.5	64.3	52.1	41.1	38.1	36.6	34.2	33.4
105	26+68.3	-22.1	76.5	72.7	63.8	51.8	40.8	37.4	35.8	34.1	32.7
106	26+68.3	-22.1	76.5	76.2	73.4	56.9	44.2	40.7	38.6	36.7	35.8
107	26+78.3	-21.5	76.5	73.2	64.4	53.0	42.6	39.1	37.6	36.3	34.8
108	26+78.3	-21.5	76.5	73.2	65.2	55.0	48.1	44.2	41.1	39.3	37.5
109	26+78.3	-21.5	76.5	72.8	64.3	53.5	43.0	40.1	37.9	36.9	35.3
110	26+78.3	-21.5	76.5	76.1	75.7	60.8	48.0	44.0	41.7	39.8	39.1
111	26+88.3	-20.9	76.5	74.0	66.5	56.1	46.9	43.1	41.2	39.1	39.4
112	26+88.3	-20.9	76.5	75.2	72.0	58.3	44.6	40.1	39.0	36.9	36.6
113	26+88.3	-20.9	76.5	73.3	64.9	53.5	42.7	39.6	37.4	36.1	34.9
114	26+88.3	-20.9	76.5	76.1	75.3	65.5	53.4	49.1	46.9	46.3	44.5
115	26+93.3	-20.6	76.5	73.9	67.0	59.1	50.6	45.6	44.9	42.5	41.4
116	26+93.3	-20.6	76.5	73.5	62.7	50.0	35.2	28.6	26.6	25.3	28.8
117	26+93.3	-20.6	76.5	73.4	62.8	50.5	37.5	34.0	32.5	30.8	29.7
118	26+93.3	-20.6	76.5	74.0	66.5	56.3	47.0	42.7	41.8	41.1	38.6
119	26+95.3	-20.6	76.5	73.5	64.6	54.8	44.1	39.8	37.0	37.0	32.8
120	26+95.3	-20.6	76.5	75.4	69.4	50.3	31.1	24.4	22.1	23.0	21.4
121	26+95.3	-20.6	76.5	73.8	66.0	56.4	47.1	41.5	41.0	38.9	37.3
122	26+95.3	-20.6	76.5	73.5	65.1	54.1	43.2	38.4	37.1	34.8	33.3
123	27+08.1	-24.25	76.5	74.3	68.6	60.6	52.0	49.0	47.8	46.1	44.5
123A	27+08.1	-24.25	76.5	74.7	68.5	60.9	52.0	48.1	47.1	45.4	43.6
124	27+18.1	-24.25	76.5	75.0	69.6	62.3	55.3	51.8	49.8	48.2	46.9
125	27+28.1	-24.25	76.5	75.5	70.5	65.4	59.3	55.8	52.3	52.5	47.8
126	27+38.1	-24.25	76.5	75.5	71.9	66.3	59.6	57.8	55.5	53.5	51.2
127	27+48.1	-24.25	76.5	76.0	72.1	68.0	63.2	59.8	57.2	55.1	53.4
128	27+58.1	-24.25	76.5	76.0	73.0	68.7	64.0	60.7	58.8	57.1	54.7
129	27+68.1	-24.25	76.5	76.4	73.1	69.4	64.4	62.2	60.0	57.8	55.3
130	27+78.1	-24.25	76.5	76.2	73.6	69.8	65.8	63.1	60.3	58.4	56.3
131	27+88.1	-24.25	76.5	76.6	74.5	71.4	66.6	64.5	62.1	60.3	58.7

									Average Piezometer Readings, Prototype Feet of Water					
T=15 LC=76.3	T=30 LC=75.5	T=45 LC=74.0	T=60 LC=72.0	T=75 LC=69.5	T=90 LC=67.4	T=105 LC=65.1	T=120 LC=63.1	T=150 LC=58.5	T=180 LC=54.7	T=240 LC=46.6	T=300 LC=39.5	T=360 LC=32.7	T=420 LC=27.5	T=480 LC=22.3
73.6	64.9	52.0	39.7	36.0	34.3	33.1	32.2	30.2	28.4	25.2	22.0	19.3	17.0	14.6
74.6	70.8	55.7	42.6	39.6	37.6	35.4	34.2	31.7	30.1	26.5	22.6	19.7	16.7	14.6
72.5	64.3	52.1	41.1	38.1	36.6	34.2	33.4	32.0	29.7	26.4	23.3	19.8	17.1	14.9
72.7	63.8	51.8	40.8	37.4	35.8	34.1	32.7	31.4	29.6	26.2	22.7	19.9	16.9	14.9
76.2	73.4	56.9	44.2	40.7	38.6	36.7	35.8	33.6	31.7	27.8	24.2	21.1	18.2	15.5
73.2	64.4	53.0	42.6	39.1	37.6	36.3	34.8	32.8	31.1	26.9	23.9	20.7	17.6	15.4
73.2	65.2	55.0	48.1	44.2	41.1	39.3	37.5	35.1	33.0	28.9	25.4	22.2	19.4	16.6
72.8	64.3	53.5	43.0	40.1	37.9	36.9	35.3	33.4	31.4	27.3	23.9	20.5	17.7	15.2
76.1	75.7	60.8	48.0	44.0	41.7	39.8	39.1	36.4	34.6	30.1	26.1	22.4	19.1	16.1
74.0	66.5	56.1	46.9	43.1	41.2	39.1	39.4	36.4	33.8	29.9	26.0	22.4	19.1	16.1
75.2	72.0	58.3	44.6	40.1	39.0	36.9	36.6	36.9	34.0	33.1	31.3	30.2	28.8	20.4
73.3	64.9	53.5	42.7	39.6	37.4	36.1	34.9	33.0	31.1	27.0	23.9	20.9	17.4	15.0
76.1	75.3	65.5	53.4	49.1	46.9	46.3	44.5	40.9	38.7	33.6	28.6	24.6	21.0	17.5
73.9	67.0	59.1	50.6	45.6	44.9	42.5	41.4	39.6	37.8	31.0	27.6	23.0	19.6	16.8
73.5	62.7	50.0	35.2	28.6	26.6	25.3	28.8	22.2	21.6	19.7	18.2	17.3	15.3	13.0
73.4	62.8	50.5	37.5	34.0	32.5	30.8	29.7	28.6	26.9	23.8	20.5	18.2	15.4	13.5
74.0	66.5	56.3	47.0	42.7	41.8	41.1	38.6	36.1	35.0	29.8	26.0	22.4	18.8	16.4
73.5	64.6	54.8	44.1	39.8	37.0	37.0	32.8	31.1	29.0	23.3	18.9	15.0	11.7	9.8
75.4	69.4	50.3	31.1	24.4	22.1	23.0	21.4	20.1	20.9	20.1	16.6	14.8	12.8	11.8
73.8	66.0	56.4	47.1	41.5	41.0	38.9	37.3	35.5	34.1	29.5	24.7	21.0	18.4	15.7
73.5	65.1	54.1	43.2	38.4	37.1	34.8	33.3	31.1	30.8	24.9	23.9	19.4	17.3	15.0
74.3	68.6	60.6	52.0	49.0	47.8	46.1	44.5	39.9	37.4	34.1	29.4	24.9	20.6	18.2
74.7	68.5	60.9	52.0	48.1	47.1	45.4	43.6	40.8	38.8	33.6	28.5	24.3	20.7	17.4
75.0	69.6	62.3	55.3	51.8	49.8	48.2	46.9	43.4	40.7	35.5	30.8	25.9	21.9	18.2
75.5	70.5	65.4	59.3	55.8	52.3	52.5	47.8	46.6	42.9	36.9	31.8	27.3	22.8	18.8
75.5	71.9	66.3	59.6	57.8	55.5	53.5	51.2	48.4	45.4	39.2	33.5	28.0	23.0	19.3
76.0	72.1	68.0	63.2	59.8	57.2	55.1	53.4	50.3	47.4	40.1	34.3	28.8	23.8	20.0
76.0	73.0	68.7	64.0	60.7	58.8	57.1	54.7	50.9	47.1	40.5	34.8	28.8	24.1	19.5
76.4	73.1	69.4	64.4	62.2	60.0	57.8	55.3	51.8	48.5	42.0	35.5	29.5	24.7	20.3
76.2	73.6	69.8	65.8	63.1	60.3	58.4	56.3	53.1	49.0	41.9	35.6	30.0	24.6	20.4
76.6	74.5	71.4	66.6	64.5	62.1	60.3	58.7	54.7	50.9	43.6	37.0	31.1	26.1	21.3

Average Piezometer Readings, Prototype Feet of Water

20 63.1	T=150 LC=58.5	T=180 LC=54.7	T=240 LC=46.6	T=300 LC=39.5	T=360 LC=32.7	T=420 LC=27.5	T=480 LC=22.3	T=540 LC=18.1	T=600 LC=14.5	T=660 LC=11.9	T=720 LC=9.3	T=780 LC=7.9	T=840 LC=7.0
	30.2	28.4	25.2	22.0	19.3	17.0	14.6	12.6	11.3	9.4	8.4	7.7	7.0
	31.7	30.1	26.5	22.6	19.7	16.7	14.6	12.5	10.6	9.4	8.4	7.8	7.0
	32.0	29.7	26.4	23.3	19.8	17.1	14.9	12.9	11.0	9.5	8.4	7.3	7.0
	31.4	29.6	26.2	22.7	19.9	16.9	14.9	12.4	11.0	9.4	8.2	7.6	7.0
	33.6	31.7	27.8	24.2	21.1	18.2	15.5	13.1	11.5	9.7	8.4	7.8	7.0
	32.8	31.1	26.9	23.9	20.7	17.6	15.4	13.3	11.3	9.9	8.6	7.7	7.0
	35.1	33.0	28.9	25.4	22.2	19.4	16.6	14.2	12.2	10.6	9.3	8.2	7.0
	33.4	31.4	27.3	23.9	20.5	17.7	15.2	13.1	11.3	9.6	8.4	7.3	7.0
	36.4	34.6	30.1	26.1	22.4	19.1	16.1	13.8	11.5	9.9	8.7	7.6	7.0
	36.4	33.8	29.9	26.0	22.4	19.1	16.1	14.1	11.7	9.9	8.7	7.6	7.0
	36.9	34.0	33.1	31.3	30.2	28.8	20.4	18.9	17.6	9.9	8.3	7.5	7.0
	33.0	31.1	27.0	23.9	20.9	17.4	15.0	12.6	11.1	9.2	8.4	7.4	7.0
	40.9	38.7	33.6	28.6	24.6	21.0	17.5	14.7	12.4	10.2	8.8	7.9	7.0
	39.6	37.8	31.0	27.6	23.0	19.6	16.8	14.1	11.7	10.0	8.7	7.6	7.0
	22.2	21.6	19.7	18.2	17.3	15.3	13.0	11.9	9.9	9.2	8.4	7.6	7.0
	28.6	26.9	23.8	20.5	18.2	15.4	13.5	12.0	10.4	8.9	8.0	7.3	7.0
	36.1	35.0	29.8	26.0	22.4	18.8	16.4	13.9	11.5	10.0	8.7	7.8	7.0
	31.1	29.0	23.3	18.9	15.0	11.7	9.8	8.3	7.8	7.4	7.0	6.8	7.0
	20.1	20.9	20.1	16.6	14.8	12.8	11.8	10.8	9.6	8.8	8.1	7.4	7.0
	35.5	34.1	29.5	24.7	21.0	18.4	15.7	13.4	11.3	9.9	8.4	7.5	7.0
	31.1	30.8	24.9	23.9	19.4	17.3	15.0	13.0	11.3	9.8	8.4	7.6	7.0
	39.9	37.4	34.1	29.4	24.9	20.6	18.2	14.6	12.4	10.3	8.9	7.5	7.0
	40.8	38.8	33.6	28.5	24.3	20.7	17.4	14.4	12.3	10.3	9.0	7.7	7.0
	43.4	40.7	35.5	30.8	25.9	21.9	18.2	15.3	12.5	10.6	9.1	7.9	7.0
	46.6	42.9	36.9	31.8	27.3	22.8	18.8	15.7	12.7	10.3	9.0	7.5	7.0
	48.4	45.4	39.2	33.5	28.0	23.0	19.3	16.0	13.3	10.8	9.2	7.7	7.0
	50.3	47.4	40.1	34.3	28.8	23.8	20.0	16.4	13.3	10.9	9.1	7.8	7.0
	50.9	47.1	40.5	34.8	28.8	24.1	19.5	16.1	13.3	10.8	9.1	7.6	7.0
	51.8	48.5	42.0	35.5	29.5	24.7	20.3	16.7	13.6	11.1	9.1	7.9	7.0
	53.1	49.0	41.9	35.6	30.0	24.6	20.4	16.8	13.4	11.2	9.3	7.6	7.0
	54.7	50.9	43.6	37.0	31.1	26.1	21.3	17.3	14.0	11.4	9.5	7.9	7.0

(Sheet 4 of 6)

Table 4 (Continued)

Piezometer Location												
No.	Station	Ele-vation	T=0 LC=76.5	T=15 LC=76.3	T=30 LC=75.5	T=45 LC=74.0	T=60 LC=72.0	T=75 LC=69.5	T=90 LC=67.4	T=105 LC=65.1	T= LC
131A	27+88.1	-24.25	76.5	76.4	73.5	69.5	64.8	62.3	59.8	58.4	56.
132	26+14.0	-24.25	76.5	67.4	59.7	46.6	36.2	33.6	32.1	29.0	29.
133	26+22.5	-24.25	76.5	66.6	56.5	39.1	24.9	21.6	21.7	19.8	18.
134	26+70.0	-17.0	76.5	65.9	57.6	41.8	29.8	27.8	27.5	24.9	24.
134A	26+70.0	-17.0	76.5	66.8	58.6	43.2	32.0	27.5	26.5	25.5	26.
135	27+85.0	-17.0	76.5	64.1	57.0	39.9	28.8	26.4	25.6	24.7	23.
135A	27+85.0	-17.0	76.5	63.5	56.2	39.6	28.3	25.3	24.2	23.9	23.
136	28+60.0	-18.0	76.5	59.7	52.7	34.9	23.3	22.7	21.5	20.2	19.
136A	28+60.0	-18.0	76.5	60.8	54.2	36.2	24.1	20.7	19.7	18.6	19.
137	28+72.0	-18.0	76.5	60.5	53.1	34.6	22.8	21.9	20.4	19.4	18.
137A	28+72.0	-18.0	76.5	59.9	53.5	34.8	23.2	20.9	19.2	18.1	18.
138	29+21.3	-18.0	7.0	3.4	-5.3	-0.9	19.8	19.8	19.1	17.2	17
138A	29+21.3	-18.0	7.0	-4.0	-3.2	-0.9	17.8	18.3	17.0	16.5	15.
139	29+28.3	-18.9	7.0	4.5	-5.0	0.1	22.0	19.2	18.1	17.5	17
140	29+37.3	-20.0	7.0	1.0	-3.4	5.2	17.7	15.6	14.8	14.1	13
141	29+70.0	-20.0	7.0	13.0	10.7	15.0	17.5	16.6	15.6	14.9	15.
141A	29+70.0	-20.0	7.0	6.3	7.8	11.7	17.0	17.1	15.7	12.3	14.
142	30+10.0	-20.0	7.0	9.0	12.9	15.6	16.7	16.7	16.3	14.9	14
143	30+57.9	-27.0	7.0	8.0	9.0	7.0	3.6	2.8	1.8	2.0	1.9
144	30+66.4	-27.0	7.0	9.6	14.0	19.6	21.8	22.3	20.8	19.5	18
145	30+14.4	-27.0	7.0	9.3	9.2	5.9	1.3	1.0	0.2	0.2	0.5
146	30+22.9	-27.0	7.0	10.2	18.6	23.7	23.3	24.0	21.8	20.6	20
147	30+23.9	-34.0	7.0	9.0	12.0	13.4	13.9	14.2	12.7	11.9	12
148	30+23.9	-34.0	7.0	8.6	11.9	14.3	14.8	14.8	13.7	13.2	13
149	30+23.9	-34.0	7.0	8.7	12.2	14.9	16.1	15.6	14.0	13.8	13
150	30+23.9	-34.0	7.0	9.0	14.4	17.9	19.0	19.0	17.7	17.4	18
151	30+23.9	-34.0	7.0	8.3	14.1	18.3	18.4	18.1	17.0	16.2	16
152	30+67.4	-34.0	7.0	8.6	11.2	13.0	13.3	12.9	12.4	10.7	10
153	30+67.4	-34.0	7.0	8.5	12.9	13.7	13.7	13.6	12.5	11.7	11
154	30+67.4	-34.0	7.0	7.9	11.5	14.5	15.5	15.6	13.9	13.4	13
155	30+67.4	-34.0	7.0	7.8	11.3	16.0	17.4	18.6	17.7	16.9	16

Average Piezometer Readings, Prototype Feet of Water

5	T=15 LC=76.3	T=30 LC=75.5	T=45 LC=74.0	T=60 LC=72.0	T=75 LC=69.5	T=90 LC=67.4	T=105 LC=65.1	T=120 LC=63.1	T=150 LC=58.5	T=180 LC=54.7	T=240 LC=46.6	T=300 LC=39.5	T=360 LC=32.7	T=420 LC=27.5	T= LC
	76.4	73.5	69.5	64.8	62.3	59.8	58.4	56.0	52.3	48.9	41.3	35.5	29.9	24.3	20.
	67.4	59.7	46.6	36.2	33.6	32.1	29.0	29.8	29.5	26.0	23.0	21.2	18.7	15.8	13.
	66.6	56.5	39.1	24.9	21.6	21.7	19.8	18.0	19.4	17.1	16.4	14.5	13.5	12.3	11.
	65.9	57.6	41.8	29.8	27.8	27.5	24.9	24.1	23.5	21.7	20.0	17.4	15.4	14.1	12.
	66.8	58.6	43.2	32.0	27.5	26.5	25.5	26.0	23.7	22.7	20.5	18.1	15.9	13.7	12.
	64.1	57.0	39.9	28.8	26.4	25.6	24.7	23.2	22.4	20.9	18.6	17.1	15.2	13.7	11.
	63.5	56.2	39.6	28.3	25.3	24.2	23.9	23.1	21.6	20.8	18.7	16.7	14.7	13.1	11.
	59.7	52.7	34.9	23.3	22.7	21.5	20.2	19.3	19.6	18.5	16.7	15.0	13.8	12.4	11.
	60.8	54.2	36.2	24.1	20.7	19.7	18.6	19.0	18.7	17.1	15.7	14.1	12.6	11.8	10.
	60.5	53.1	34.6	22.8	21.9	20.4	19.4	18.8	18.6	17.9	16.3	14.5	13.1	12.2	10.
	59.9	53.5	34.8	23.2	20.9	19.2	18.1	18.4	17.5	16.8	15.2	13.8	12.8	11.3	10.
	3.4	-5.3	-0.9	19.8	19.8	19.1	17.2	17.2	16.2	15.8	13.5	11.8	10.1	9.5	8.5
	-4.0	-3.2	-0.9	17.8	18.3	17.0	16.5	15.4	14.6	14.2	12.6	11.2	10.3	8.8	8.3
	4.5	-5.0	0.1	22.0	19.2	18.1	17.5	17.0	16.0	15.1	13.4	11.5	10.3	9.3	8.6
	1.0	-3.4	5.2	17.7	15.6	14.8	14.1	13.7	13.4	12.6	11.4	10.4	9.6	8.8	8.2
	13.0	10.7	15.0	17.5	16.6	15.6	14.9	15.6	13.9	13.2	11.3	10.6	9.6	9.0	8.2
	6.3	7.8	11.7	17.0	17.1	15.7	12.3	14.5	13.8	12.2	11.8	10.5	8.7	8.5	8.3
	9.0	12.9	15.6	16.7	16.7	16.3	14.9	14.3	13.7	13.1	11.7	10.6	9.6	8.0	8.5
	8.0	9.0	7.0	3.6	2.8	1.8	2.0	1.9	3.3	3.8	4.4	5.0	6.0	6.2	6.5
	9.6	14.0	19.6	21.8	22.3	20.8	19.5	18.9	17.9	16.5	14.4	12.5	10.9	9.6	8.7
	9.3	9.2	5.9	1.3	1.0	0.2	0.2	0.5	2.2	2.6	3.8	5.0	5.5	6.0	6.6
	10.2	18.6	23.7	23.3	24.0	21.8	20.6	20.0	18.9	17.9	12.6	13.0	11.3	9.9	9.0
	9.0	12.0	13.4	13.9	14.2	12.7	11.9	12.2	11.4	11.3	10.8	9.6	8.8	8.3	7.7
	8.6	11.9	14.3	14.8	14.8	13.7	13.2	13.0	12.7	12.5	11.9	11.2	10.3	9.9	9.4
	8.7	12.2	14.9	16.1	15.6	14.0	13.8	13.3	12.9	12.4	11.0	10.0	9.3	8.5	8.2
	9.0	14.4	17.9	19.0	19.0	17.7	17.4	18.5	15.5	14.6	13.3	11.5	10.3	9.6	8.5
	8.3	14.1	18.3	18.4	18.1	17.0	16.2	16.0	14.4	14.4	12.9	11.1	11.5	9.0	8.4
	8.6	11.2	13.0	13.3	12.9	12.4	10.7	10.8	10.9	10.4	9.6	9.1	8.6	8.5	8.0
	8.5	12.9	13.7	13.7	13.6	12.5	11.7	11.5	11.7	11.2	9.9	9.4	8.6	8.2	7.9
	7.9	11.5	14.5	15.5	15.6	13.9	13.4	13.1	13.1	12.3	10.8	9.9	9.2	8.5	7.9
	7.8	11.3	16.0	17.4	18.6	17.7	16.9	16.4	15.9	15.5	14.0	12.3	11.3	10.4	9.5

	Average Piezometer Readings, Prototype Feet of Water												
20 63.1	T=150 LC=58.5	T=180 LC=54.7	T=240 LC=46.6	T=300 LC=39.5	T=360 LC=32.7	T=420 LC=27.5	T=480 LC=22.3	T=540 LC=18.1	T=600 LC=14.5	T=660 LC=11.9	T=720 LC=9.3	T=780 LC=7.9	T=840 LC=7.0
	52.3	48.9	41.3	35.5	29.9	24.3	20.4	16.8	13.4	10.8	9.2	7.7	7.0
	29.5	26.0	23.0	21.2	18.7	15.8	13.6	12.1	9.8	9.0	8.4	7.8	7.0
	19.4	17.1	16.4	14.5	13.5	12.3	11.2	10.0	9.2	8.4	7.6	7.5	7.0
	23.5	21.7	20.0	17.4	15.4	14.1	12.3	10.9	9.6	9.0	8.1	7.4	7.0
	23.7	22.7	20.5	18.1	15.9	13.7	12.2	11.1	9.9	8.6	8.2	7.6	7.0
	22.4	20.9	18.6	17.1	15.2	13.7	11.6	10.6	9.6	8.5	8.0	7.2	7.0
	21.6	20.8	18.7	16.7	14.7	13.1	11.8	10.6	9.4	8.8	8.0	7.6	7.0
	19.6	18.5	16.7	15.0	13.8	12.4	11.1	10.1	9.1	8.2	7.9	7.2	7.0
	18.7	17.1	15.7	14.1	12.6	11.8	10.5	9.3	8.4	7.9	7.4	7.1	7.0
	18.6	17.9	16.3	14.5	13.1	12.2	10.5	9.7	9.0	8.3	7.7	7.3	7.0
	17.5	16.8	15.2	13.8	12.8	11.3	10.0	9.2	8.8	8.0	7.6	7.2	7.0
	16.2	15.8	13.5	11.8	10.1	9.5	8.5	8.0	7.4	7.3	7.1	7.0	7.0
	14.6	14.2	12.6	11.2	10.3	8.8	8.3	7.9	7.5	7.3	7.1	7.0	7.0
	16.0	15.1	13.4	11.5	10.3	9.3	8.6	8.0	7.5	7.2	7.1	7.0	7.0
	13.4	12.6	11.4	10.4	9.6	8.8	8.2	7.8	7.3	7.2	7.1	6.9	7.0
	13.9	13.2	11.3	10.6	9.6	9.0	8.2	6.7	7.4	7.2	7.1	7.0	7.0
	13.8	12.2	11.8	10.5	8.7	8.5	8.3	7.6	7.3	7.1	7.0	7.0	7.0
	13.7	13.1	11.7	10.6	9.6	8.0	8.5	7.8	7.6	7.2	7.1	7.0	7.0
	3.3	3.8	4.4	5.0	6.0	6.2	6.5	6.7	6.9	6.9	7.0	7.0	7.0
	17.9	16.5	14.4	12.5	10.9	9.6	8.7	8.1	7.8	7.3	7.1	7.0	7.0
	2.2	2.6	3.8	5.0	5.5	6.0	6.6	6.8	6.9	6.9	7.0	7.0	7.0
	18.9	17.9	12.6	13.0	11.3	9.9	9.0	8.2	7.5	6.5	7.1	7.0	7.0
	11.4	11.3	10.8	9.6	8.8	8.3	7.7	7.5	7.2	7.2	7.2	7.0	7.0
	12.7	12.5	11.9	11.2	10.3	9.9	9.4	8.9	8.3	8.1	7.5	7.4	7.0
	12.9	12.4	11.0	10.0	9.3	8.5	8.2	7.7	7.4	7.2	7.0	7.1	7.0
	15.5	14.6	13.3	11.5	10.3	9.6	8.5	8.1	7.6	7.3	7.1	7.0	7.0
	14.4	14.4	12.9	11.1	11.5	9.0	8.4	7.8	7.4	7.2	7.0	7.0	7.0
	10.9	10.4	9.6	9.1	8.6	8.5	8.0	7.5	7.2	7.2	7.0	7.0	7.0
	11.7	11.2	9.9	9.4	8.6	8.2	7.9	7.6	7.2	7.1	7.0	7.0	7.0
	13.1	12.3	10.8	9.9	9.2	8.5	7.9	7.6	7.3	7.2	7.1	7.0	7.0
	15.9	15.5	14.0	12.3	11.3	10.4	9.5	8.8	8.2	7.8	7.4	7.2	7.0

(Sheet 5 of 6)

Table 4 (Concluded)

Piezometer Location												
No.	Station	Ele-vation	T=0 LC=76.5	T=15 LC=76.3	T=30 LC=75.5	T=45 LC=74.0	T=60 LC=72.0	T=75 LC=69.5	T=90 LC=67.4	T=105 LC=65.1	T=12 LC=6
156	30+67.4	-34.0	7.0	8.7	12.2	17.9	19.2	19.2	18.1	17.0	16.3
157	30+16.8	-29.5	7.0	7.6	6.7	7.5	0.9	-6.8	-5.1	-5.8	-5.3
158	30+31.0	-29.5	7.0	7.7	2.5	-5.6	-2.8	-2.9	-3.8	-3.0	-0.8
159	30+60.3	-29.5	7.0	6.8	6.0	1.7	-4.9	-3.6	-3.9	-6.0	-4.6
160	30+74.5	-29.5	7.0	6.3	6.4	0.9	-1.8	2.2	-0.1	-0.2	0.1
161	22+57.6	-24.0	76.5	70.6	65.3	58.5	48.8	45.8	44.3	41.4	40.2
162	22+57.6	-26.4	76.5	70.4	63.5	51.9	42.8	40.3	39.1	37.2	36.4
163	22+60.6	-24.0	76.5	75.5	68.5	53.8	44.3	41.3	40.3	37.7	37.3
164	22+60.6	-26.4	76.5	69.0	61.8	53.8	47.7	45.1	43.2	40.3	39.4
165	29+25.8	-32.3	7.0	-5.9	-18.3	-7.6	12.9	13.9	12.2	12.3	12.0
166	29+28.8	-33.0	7.0	3.1	0.1	6.3	19.0	19.9	18.7	18.2	17.9
167	29+31.8	-33.7	7.0	8.2	7.0	12.1	22.2	22.8	21.3	21.0	20.5

									Average Piezometer Readings, Prototype Feet of Water						
5	T=15 LC=76.3	T=30 LC=75.5	T=45 LC=74.0	T=60 LC=72.0	T=75 LC=69.5	T=90 LC=67.4	T=105 LC=65.1	T=120 LC=63.1	T=150 LC=58.5	T=180 LC=54.7	T=240 LC=46.6	T=300 LC=39.5	T=360 LC=32.7	T=420 LC=27.5	T=480 LC=22.3
	8.7	12.2	17.9	19.2	19.2	18.1	17.0	16.3	15.5	14.4	12.8	11.3	10.5	9.2	8.2
	7.6	6.7	7.5	0.9	-6.8	-5.1	-5.8	-5.3	-4.7	-2.7	-0.6	1.5	2.3	3.4	3.8
	7.7	2.5	-5.6	-2.8	-2.9	-3.8	-3.0	-0.8	0.6	1.5	1.9	3.5	4.1	5.2	6.0
	6.8	6.0	1.7	-4.9	-3.6	-3.9	-6.0	-4.6	-2.6	-3.0	0.2	1.6	2.9	4.1	5.4
	6.3	6.4	0.9	-1.8	2.2	-0.1	-0.2	0.1	2.3	3.2	4.2	4.6	5.9	5.9	6.3
	70.6	65.3	58.5	48.8	45.8	44.3	41.4	40.2	37.4	34.0	29.7	26.0	21.2	18.1	15.8
	70.4	63.5	51.9	42.8	40.3	39.1	37.2	36.4	33.8	31.6	27.5	24.6	20.7	17.8	15.6
	75.5	68.5	53.8	44.3	41.3	40.3	37.7	37.3	34.4	31.7	28.2	24.7	20.7	17.8	15.1
	69.0	61.8	53.8	47.7	45.1	43.2	40.3	39.4	36.4	33.7	29.4	25.5	21.4	18.3	16.0
	-5.9	-18.3	-7.6	12.9	13.9	12.2	12.3	12.0	11.8	11.5	11.4	10.3	9.9	9.5	8.9
	3.1	0.1	6.3	19.0	19.9	18.7	18.2	17.9	16.6	16.4	15.2	13.9	12.3	11.4	10.6
	8.2	7.0	12.1	22.2	22.8	21.3	21.0	20.5	18.7	18.2	16.8	15.4	13.2	12.5	11.0

=120 C=63.1	Average Piezometer Readings, Prototype Feet of Water T=150 LC=58.5	T=180 LC=54.7	T=240 LC=46.6	T=300 LC=39.5	T=360 LC=32.7	T=420 LC=27.5	T=480 LC=22.3	T=540 LC=18.1	T=600 LC=14.5	T=660 LC=11.9	T=720 LC=9.3	T=780 LC=7.9	T=840 LC=7.0
6.3	15.5	14.4	12.8	11.3	10.5	9.2	8.2	7.8	7.4	7.2	7.2	7.0	7.0
.3	-4.7	-2.7	-0.6	1.5	2.3	3.4	3.8	5.3	6.0	7.0	6.9	7.4	7.0
.8	0.6	1.5	1.9	3.5	4.1	5.2	6.0	6.5	6.9	6.8	7.0	7.2	7.0
.6	-2.6	-3.0	0.2	1.6	2.9	4.1	5.4	5.9	6.4	6.6	7.1	6.8	7.0
1	2.3	3.2	4.2	4.6	5.9	5.9	6.3	6.8	6.7	7.0	6.8	7.1	7.0
0.2	37.4	34.0	29.7	26.0	21.2	18.1	15.8	13.5	10.8	10.0	8.5	7.8	7.0
6.4	33.8	31.6	27.5	24.6	20.7	17.8	15.6	13.2	11.2	9.6	8.2	7.7	7.0
7.3	34.4	31.7	28.2	24.7	20.7	17.8	15.1	13.2	10.9	9.7	8.8	7.6	7.0
9.4	36.4	33.7	29.4	25.5	21.4	18.3	16.0	13.6	11.3	10.0	9.2	8.0	7.0
2.0	11.8	11.5	11.4	10.3	9.9	9.5	8.9	8.3	7.9	7.5	7.2	7.2	7.0
7.9	16.6	16.4	15.2	13.9	12.3	11.4	10.6	9.3	8.8	7.9	7.4	7.1	7.0
0.5	18.7	18.2	16.8	15.4	13.2	12.5	11.0	9.8	9.1	8.2	7.6	6.9	7.0

(Sheet 6 of 6)

Table 5
H Pattern System, Piezometer Readings Under Steady-Flow Conditions, Type 14 Design, Normal Valve Filling, Upper Pool El 76.5, Lock Chamber Water-Surface El 10.0, Discharge 13,400 cfs

No.	Station	El	Elevation Referenced to NGVD
Intake Manifold			
1	21+17.8	-16.0	73.9
3	21+22.9	-16.0	74.4
4	21+29.5	-16.0	70.7
6	21+36.2	-16.0	72.5
7	21+42.5	-16.0	66.5
9	21+49.7	-16.0	70.4
10	21+55.9	-16.0	66.9
Filling Culverts			
11	21+70.0	-13.6	48.8
14	22+05.0	-17.0	46.6
14A	22+05.0	-17.0	45.3
15	22+52.1	-17.0	40.6
15A	22+52.1	-17.0	34.0
21	22+90.6	-16.5	41.0
21A	22+90.6	-16.5	26.0
24	25+50.0	-16.5	36.3
24A	25+50.0	-16.5	32.5
27	26+09.2	-17.0	32.0
27A	26+09.2	-17.0	31.2
Crossover			
30	25+96.0	-20.1	2.5
32	25+88.1	-20.1	2.0
36	25+96.0	-28.4	5.7
38	25+88.1	-28.4	4.1
82	26+22.4	-28.4	5.7
84	26+30.3	-28.4	4.4
88	26+22.4	-20.1	1.6

(Continued)

Table 6
H Pattern System, Piezometer Readings Under Steady-Flow Conditions, Type 14 Design, Right Single Valve Filling, Upper Pool El 76.7, Lock Chamber Water-Surface El 5.3, Discharge 8,100 cfs

No.	Station	El	Elevation Referenced to NGVD
Intake Manifold			
1	21+17.8	-16.0	73.1
3	21+22.9	-16.0	73.5
4	21+29.5	-16.0	68.3
6	21+36.2	-16.0	70.9
7	21+42.5	-16.0	63.4
9	21+49.7	-16.0	67.8
10	21+55.9	-16.0	61.1
Filling Culverts			
11	21+70.0	-13.6	36.3
14	22+05.0	-17.0	33.0
15	22+52.1	-17.0	25.1
21	22+90.6	-16.5	29.1
24	25+50.0	-16.5	20.1
27	26+09.2	-17.0	12.5
Crossover			
30	25+96.0	-20.1	-30.7
32	25+88.1	-20.1	-31.1
36	25+96.0	-28.4	-11.6
38	25+88.1	-28.4	-12.2
82	26+22.4	-28.4	-26.6
84	26+30.3	-28.4	-28.2
88	26+22.4	-20.1	-11.8
90	26+30.3	-20.1	-12.1
Chamber Manifolds			
71	25+10.2	-24.25	13.9
71A	25+10.2	-24.25	5.6
79	24+30.2	-24.25	9.0

(Continued)

Table 7
H Pattern System, Piezometer Readings Under Steady-Flow Conditions, Type 14 Design, Left Single Valve Filling, Upper Pool El 76.7, Lock Chamber Water-Surface El 5.5, Discharge 8,300 cfs

No.	Station	El	Elevation Referenced to NGVD
Filling Culverts			
14A	22+05.0	-17.0	30.0
15A	22+52.1	-17.0	26.7
21A	22+90.6	-16.5	26.9
24A	25+50.0	-16.5	19.9
27A	26+09.2	-17.0	10.5
Crossover			
30	25+96.0	-20.1	-13.0
32	25+88.1	-20.1	-13.2
36	25+96.0	-28.4	-29.8
38	25+88.1	-28.4	-31.0
82	26+22.4	-28.4	-13.0
84	26+30.3	-28.4	-13.1
88	26+22.4	-20.1	-34.2
90	26+30.3	-20.1	-34.4
Chamber Manifolds			
71	25+10.2	-24.25	16.8
71A	25+10.2	-24.25	13.4
79	24+30.2	-24.25	24.5
79A	24+30.2	-24.25	10.6
123	27+08.1	-24.25	7.0
123A	27+08.1	-24.25	12.8
131	27+88.1	-24.25	10.9
131A	27+88.1	-24.25	27.0

Table 8
H Pattern System, Piezometer Readings Under Steady-Flow Conditions, Type 14 Design, Normal Valve Emptying, Lock Chamber Water-Surface El 76.3, Lower Pool El 6.4, Discharge 10,600 cfs

No.	Station	El	Elevation Referenced to NGVD
Chamber Manifolds			
71	25+10.2	-24.25	50.8
71A	25+10.2	-24.25	47.6
79	24+30.2	-24.25	67.1
79A	24+30.2	-24.25	68.0
123	27+08.1	-24.25	53.3
123A	27+08.1	-24.25	51.8
131	27+88.1	-24.25	68.5
131A	27+88.1	-24.25	67.6
Cross Over			
30	25+96.0	-20.1	21.4
32	25+88.1	-20.1	21.2
36	25+96.0	-28.4	24.8
38	25+88.1	-28.4	24.7
82	26+22.4	-28.4	27.9
84	26+30.3	-28.4	27.8
88	26+22.4	-20.1	24.5
90	26+30.3	-20.1	24.4
Emptying Culverts			
27	26+09.2	-17.0	34.0
27A	26+09.2	-17.0	36.0
134	26+70.0	-17.0	28.4
134A	26+70.0	-17.0	28.6
135	27+85.0	-17.0	25.7
135A	27+85.0	-17.0	25.9
137	28+72.0	-18.0	20.9
137A	28+72.0	-18.0	20.2
138	29+21.3	-18.0	20.3

(Continued)

Table 8 (Concluded)			
No.	Station	El	Elevation Referenced to NGVD
Emptying Culverts (Continued)			
138A	29+21.3	-18.0	19.9
Outlet Manifolds			
147	30+23.9	-34.0	13.9
151	30+23.9	-34.0	18.5
152	30+67.4	-34.0	12.6
156	30+67.4	-34.0	20.1

Table 9
H Pattern System, Piezometer Readings Under Steady-Flow Conditions, Type 14 Design, Right Single Valve Emptying, Lock Chamber Water-Surface El 76.8, Lower Pool El 2.6, Discharge 6,200 cfs

No.	Station	Elevation	Elevation Referenced to NGVD
Chamber Manifolds			
71	25+10.2	-24.25	67.5
71A	25+10.2	-24.25	66.2
79	24+30.2	-24.25	73.3
79A	24+30.2	-24.25	73.6
123	27+08.1	-24.25	68.4
123A	27+08.1	-24.25	67.9
131	27+88.1	-24.25	73.5
131A	27+88.1	-24.25	73.5
Crossover			
30	25+96.0	-20.1	21.7
32	25+88.1	-20.1	20.8
36	25+96.0	-28.4	68.0
38	25+88.1	-28.4	67.7
82	26+22.4	-28.4	29.5
84	26+30.3	-28.4	29.2
88	26+22.4	-20.1	67.7
90	26+30.3	-20.1	67.2
Emptying Culverts			
27	26+09.2	-17.0	37.2
134	26+70.0	-17.0	29.6
135	27+85.0	-17.0	26.2
137	28+72.0	-18.0	20.0
138	29+21.3	-18.0	16.4
Outlet Manifolds			
147	30+23.9	-34.0	10.8
151	30+23.9	-34.0	17.3
152	30+67.4	-34.0	2.4
156	30+67.4	-34.0	2.4

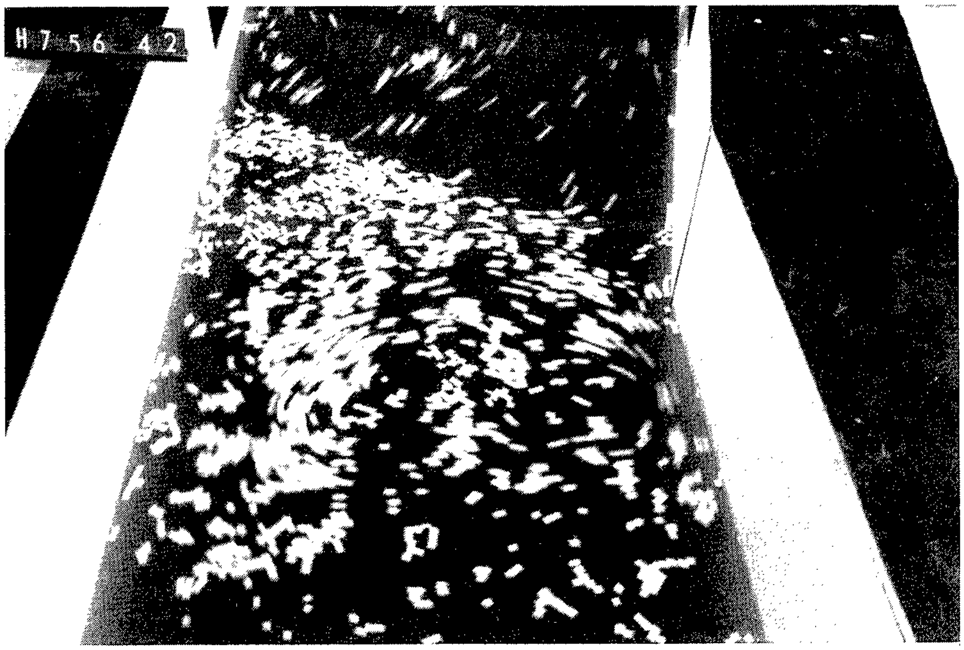
Table 10
H Pattern System, Piezometer Readings Under Steady-Flow Conditions, Type 14 Design, Left Single Valve Emptying, Lock Chamber Water-Surface El 76.8, Lower Pool El 2.6, Discharge 6,200 cfs

No.	Station	Elevation	Elevation Referenced to NGVD
Chamber Manifolds			
71	25+10.2	-24.25	67.8
71A	25+10.2	-24.25	66.8
79	24+30.2	-24.25	73.5
79A	24+30.2	-24.25	73.5
123	27+08.1	-24.25	67.9
123A	27+08.1	-24.25	67.5
131	27+88.1	-24.25	73.5
131A	27+88.1	-24.25	73.5
Crossover			
30	25+96.0	-20.1	67.8
32	25+88.1	-20.1	67.0
36	25+96.0	-28.4	24.2
38	25+88.1	-28.4	24.1
82	26+22.4	-28.4	68.0
84	26+30.3	-28.4	67.8
88	26+22.4	-20.1	26.2
90	26+30.3	-20.1	24.2
Emptying Culverts			
27A	26+09.2	-17.0	39.6
134A	26+70.0	-17.0	31.5
135A	27+85.0	-17.0	27.8
137A	28+72.0	-18.0	19.4
138A	29+21.3	-18.0	15.6
Outlet Manifolds			
147	30+23.9	-34.0	3.1
151	30+23.9	-34.0	2.6
152	30+67.4	-34.0	10.2
156	30+67.4	-34.0	20.3

a. 1 min after filling started

b. 3 min after filling started

Photo 1. H-H pattern system, confetti accenting surface currents in the vicinity of intakes during filling operations with the type 2 design lock approach and intakes. Upper pool el 76.5; initial lower pool el 7.0; 1-min normal valve time; time exposure 5 sec (prototype) (Continued)



c. 6 min after filling started

Photo 1. (Concluded)

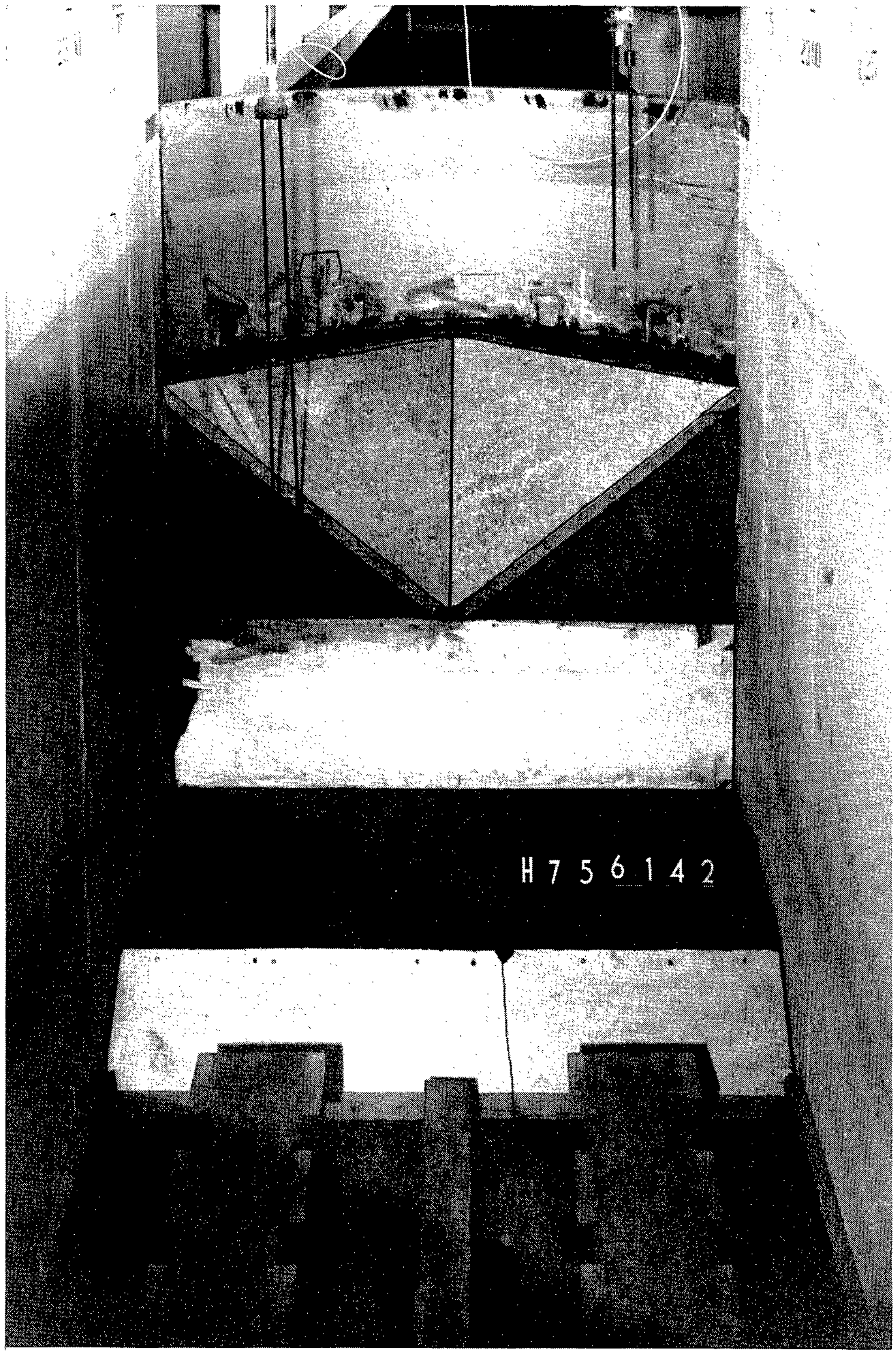


Photo 2. Looking upstream at the V-notch modification in the high sill with the curved miter gate in place, H-H pattern system

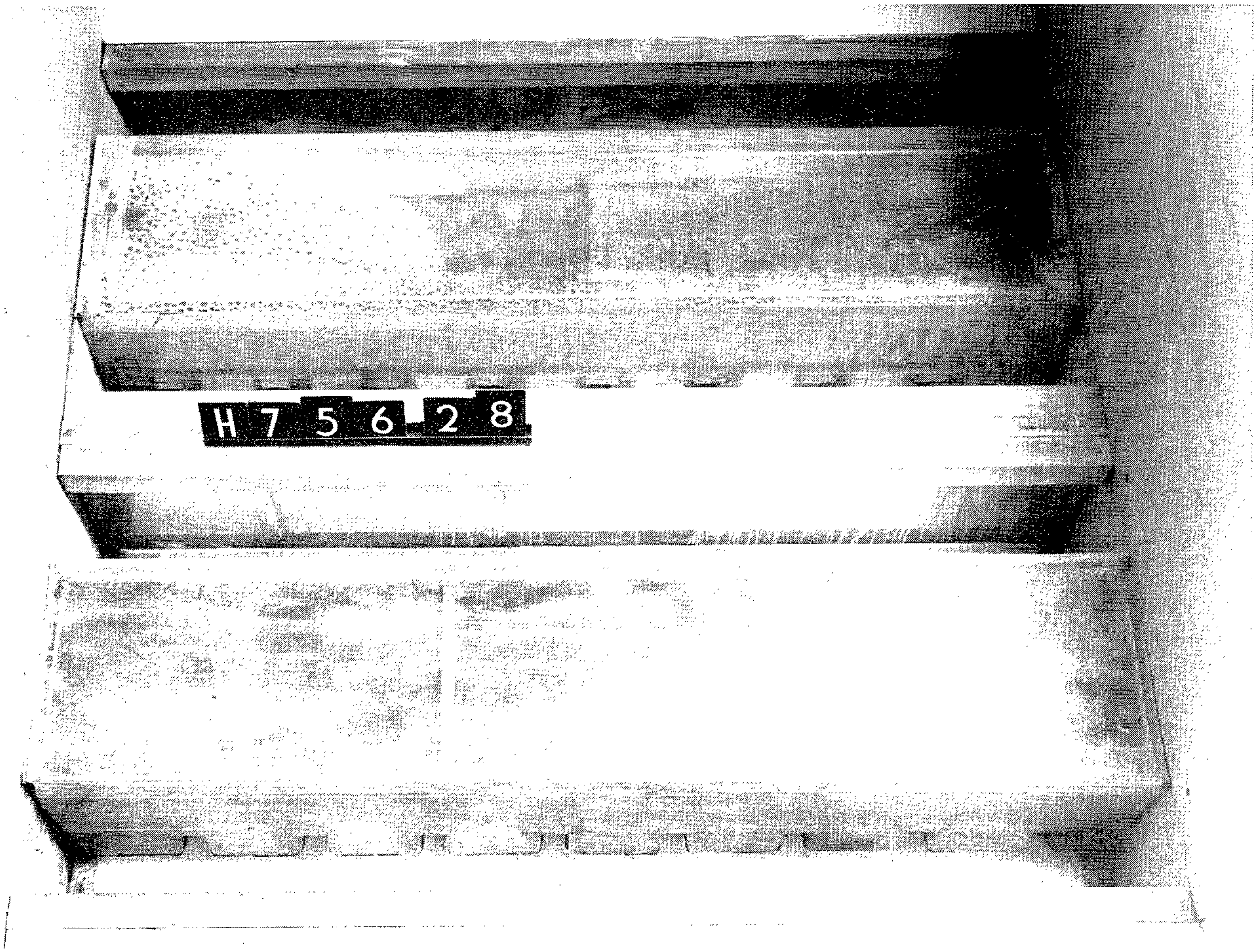
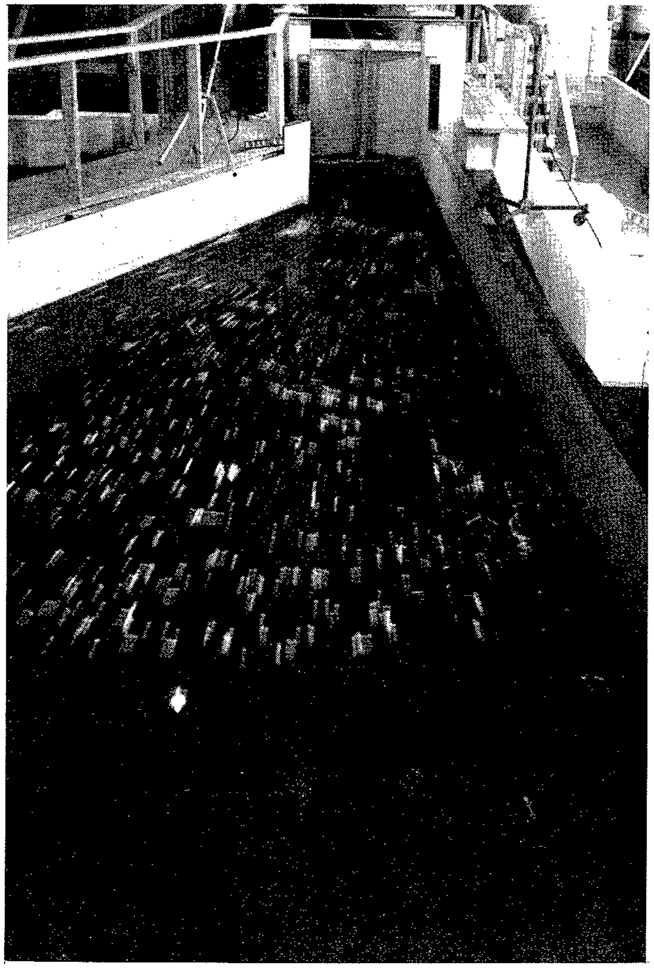
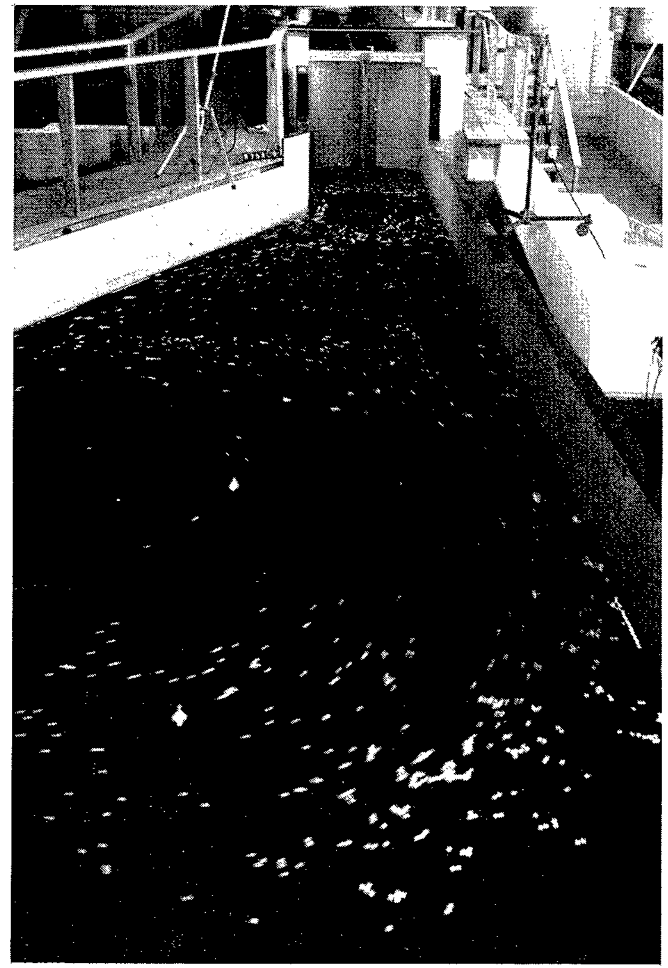


Photo 3. Type 1 (original) design discharge laterals, H-H pattern system

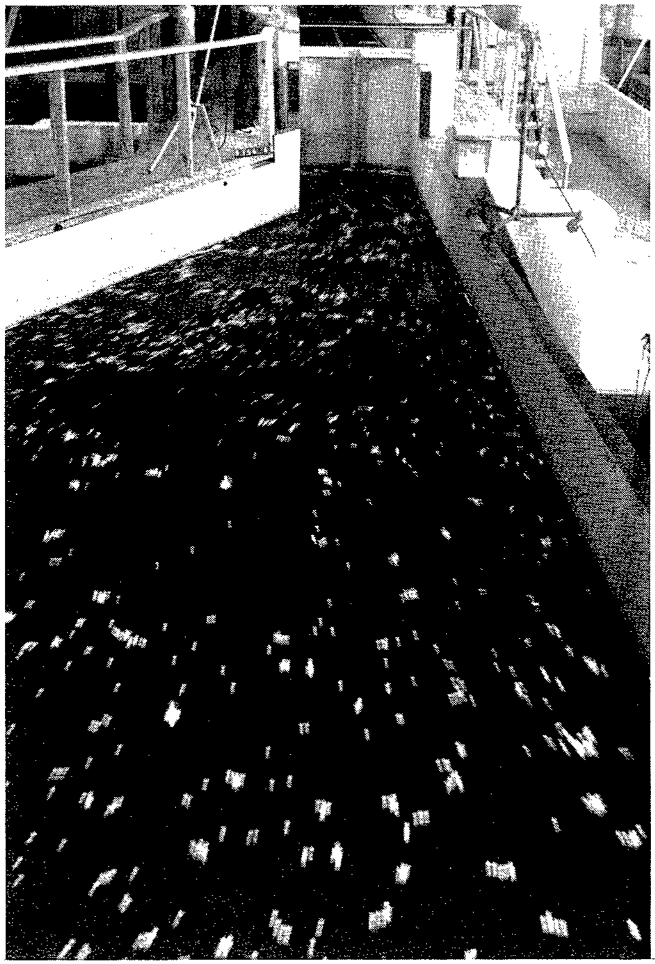


a. Normal valve time



b. Single valve time

Photo 4. Confetti accenting surface currents at the maximum discharge, type 1 (original) outlets and approach channel; H-H pattern system; upper pool el 76.5; lower pool el 5.0; exposure time 5 sec (prototype); 1-min valve time

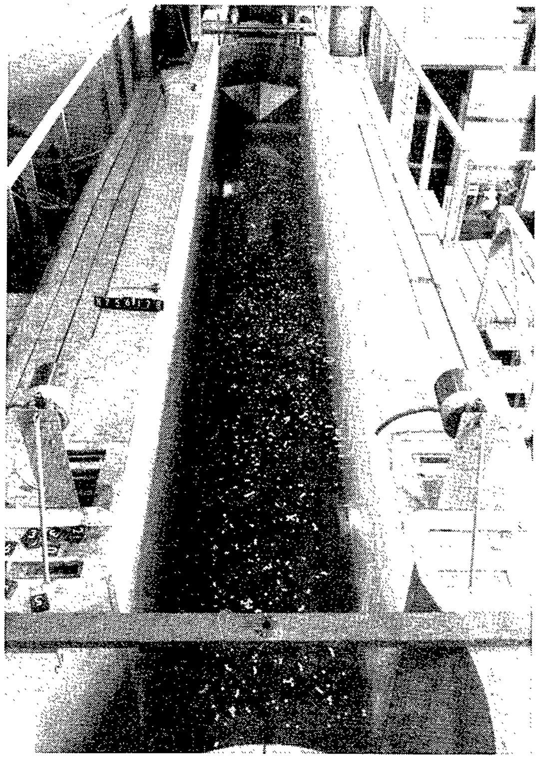


a. Normal valve time

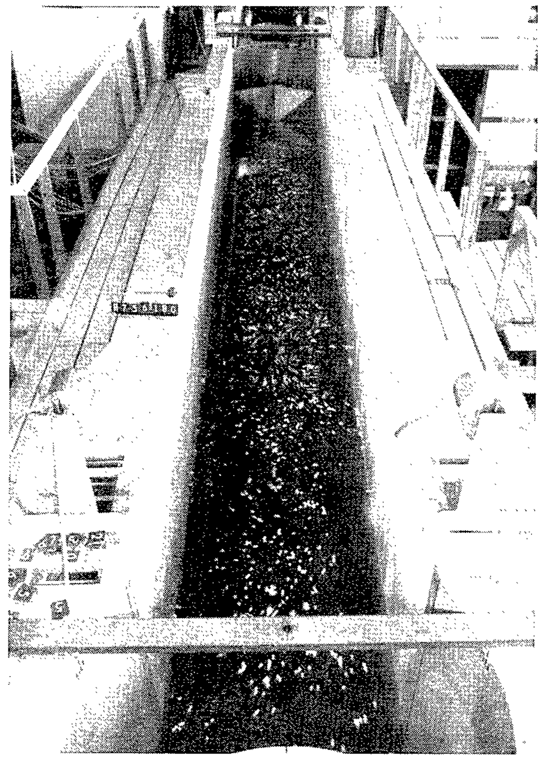
b. Single valve time

Photo 5. Confetti accenting surface currents at the maximum discharge, type 1 (original) outlets and approach channel; H-H pattern system; upper pool el 76.5; lower pool el 5.0; exposure time 5 sec (prototype); 4-min valve time

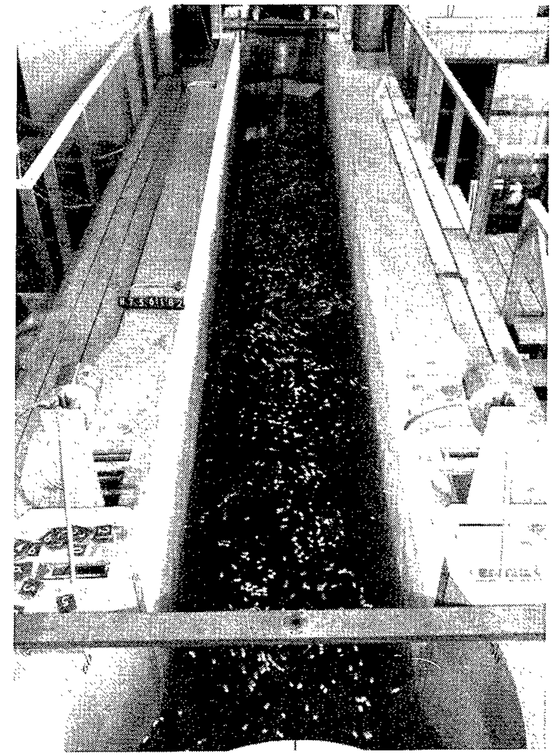
134



a. As filling started

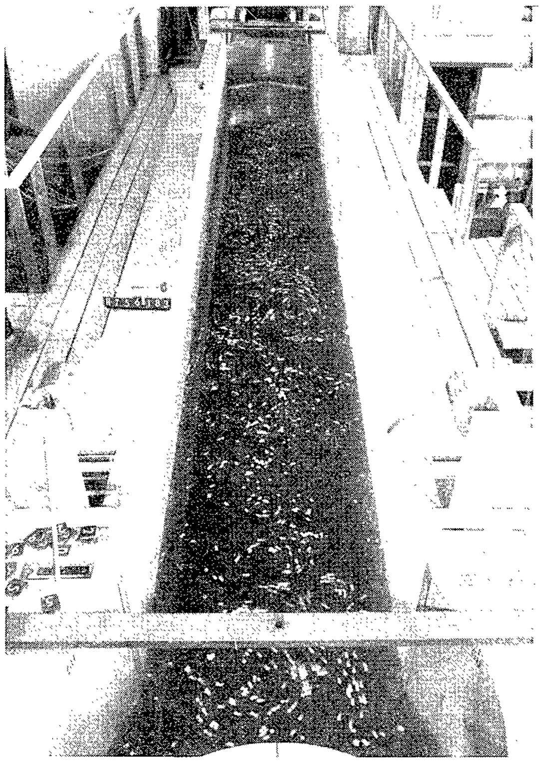


b. 1.5 min after filling started

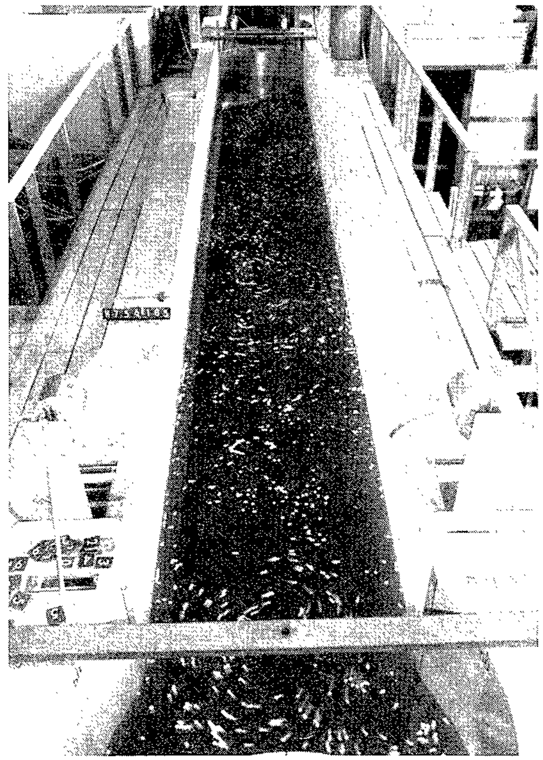


c. 3.0 min after filling started

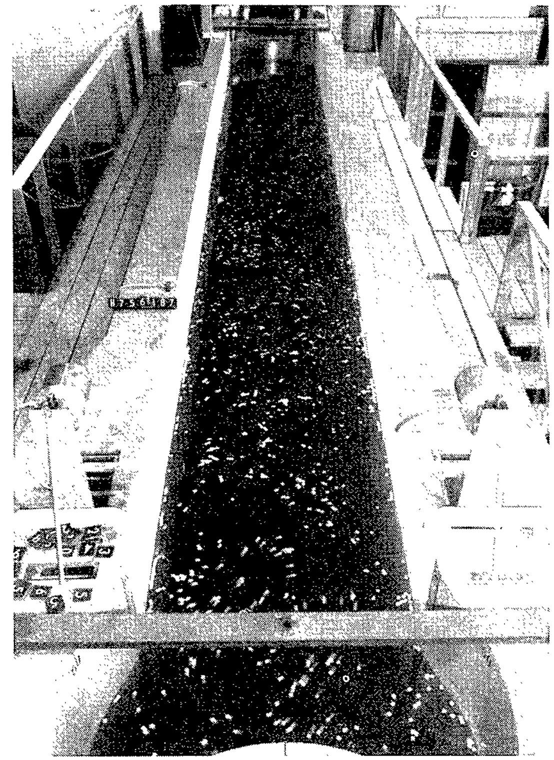
Photo 6. Confetti accenting surface currents in lock chamber during filling operations, H-H pattern system, type 6 design; 1-min valve time; upper pool el 76.5; lower pool el 7.0; time exposure 5 sec (prototype) (Continued)



d. 4.0 min after filling started

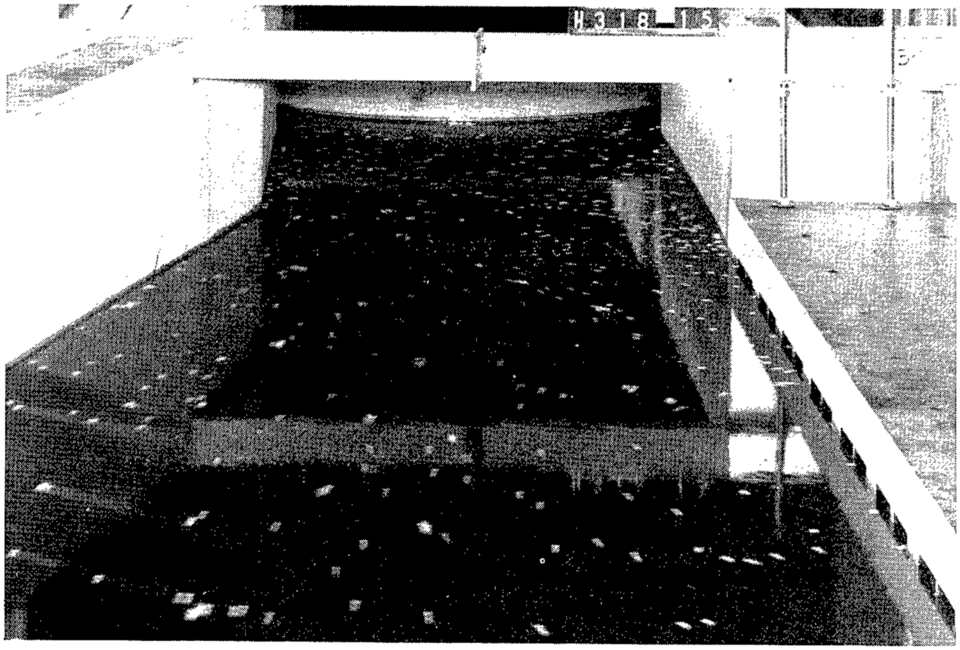


e. 6.0 min after filling started

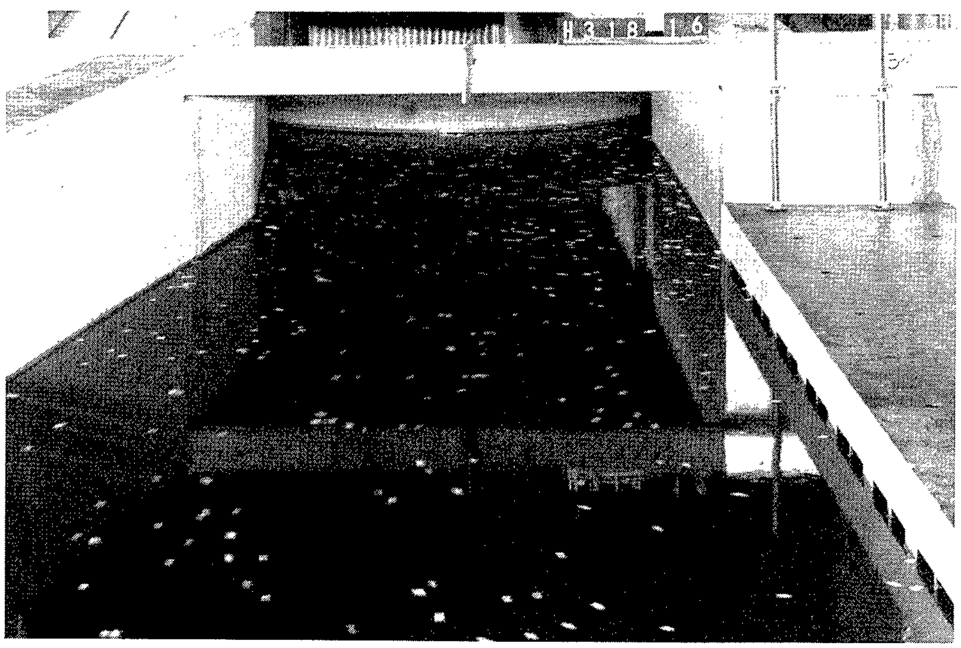


f. 8.0 min after filling started

Photo 6. (Concluded)

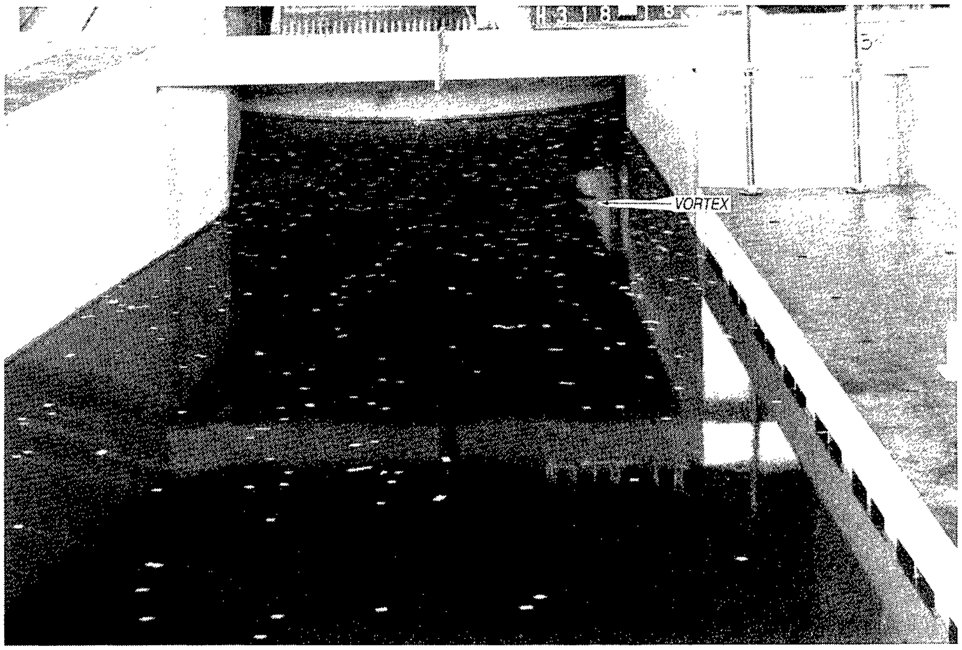


a. 3.5 min after filling started



b. 5.0 min after filling started

Photo 7. Surface currents in approach during filling operations, H pattern system with type 1 (original) design approach; upper pool el 76.5 and initial lower pool el 7.0; 1-min valve time; time exposure 5 sec (prototype) (Continued)



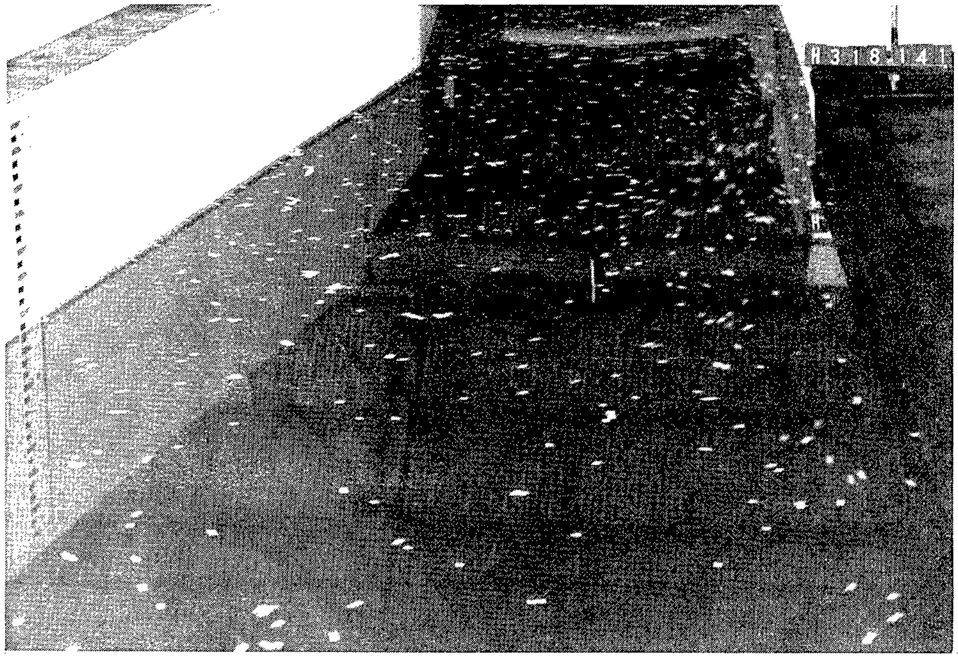
c. 9.0 min after filling started

Photo 7. (Concluded)

a. 3.5 min after filling started

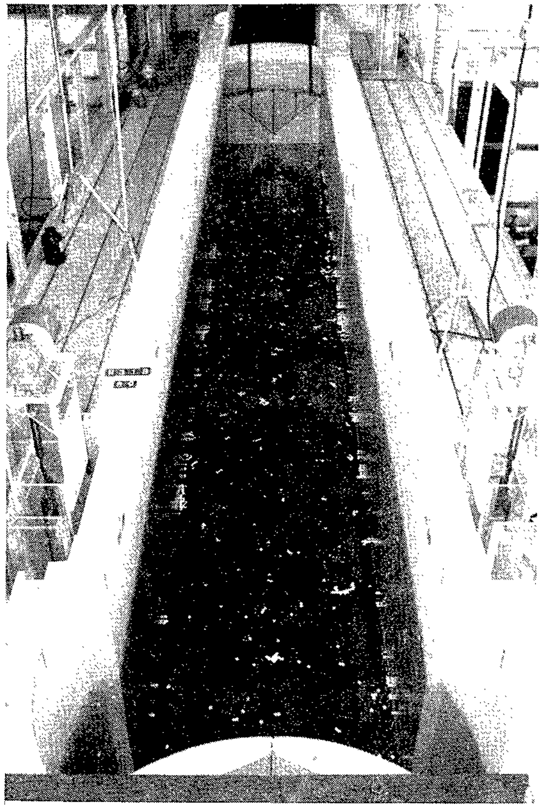
b. 5.0 min after filling started

Photo 8. Surface currents in approach during filling operations, H pattern system with type 36 design approach; upper pool el 76.5 and initial lower pool el 7.0; 1-min valve time; time exposure 5 sec (prototype) (Continued)

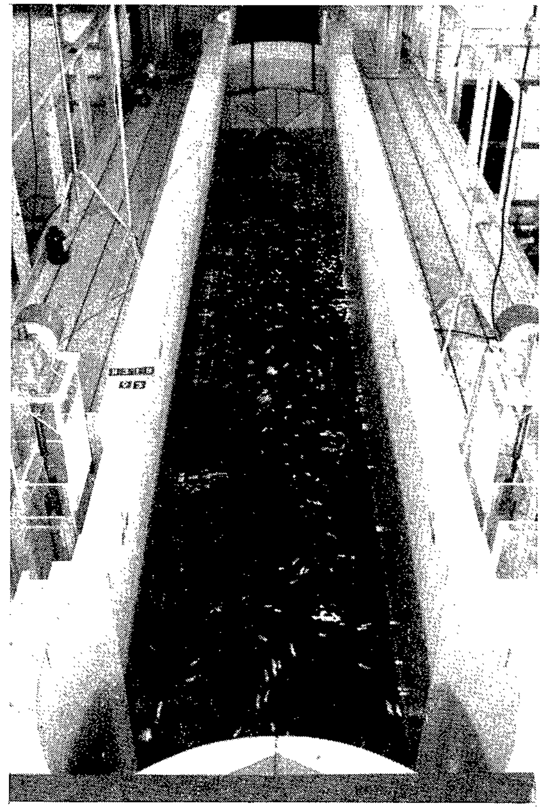


c. 9.0 min after filling started

Photo 8. (Concluded)



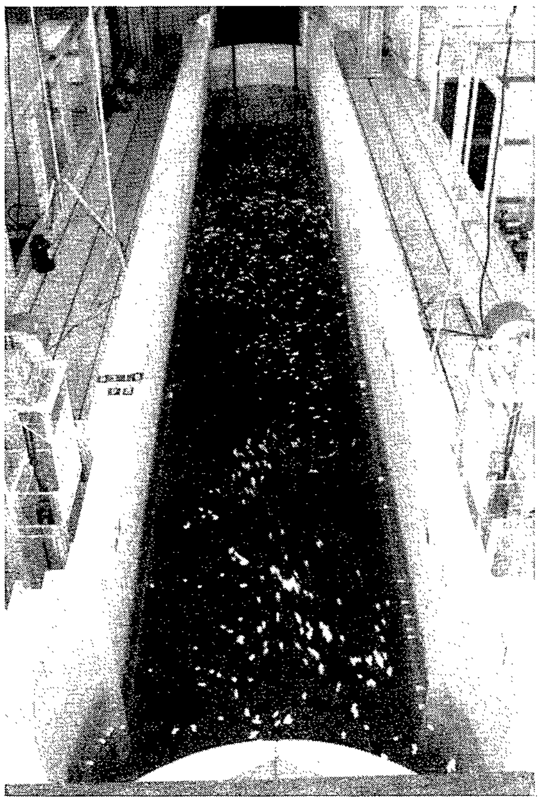
a. As filling started



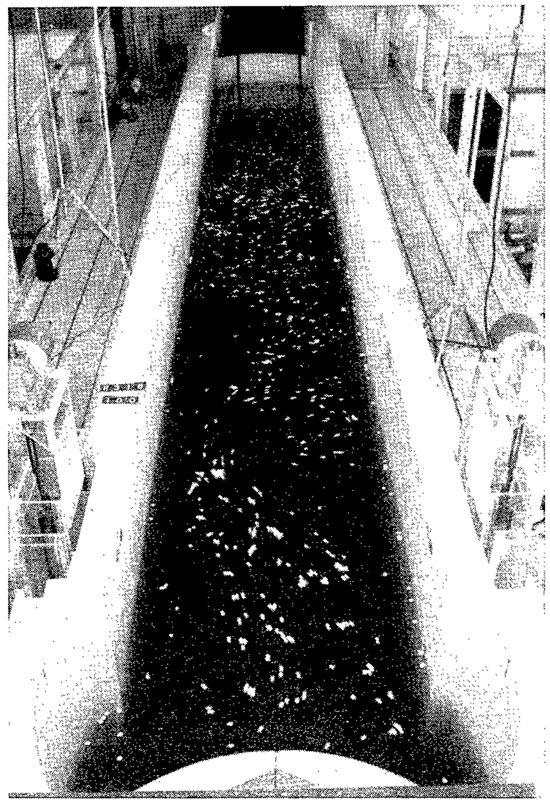
b. 1.5 min after filling started

c. 3.0 min after filling started

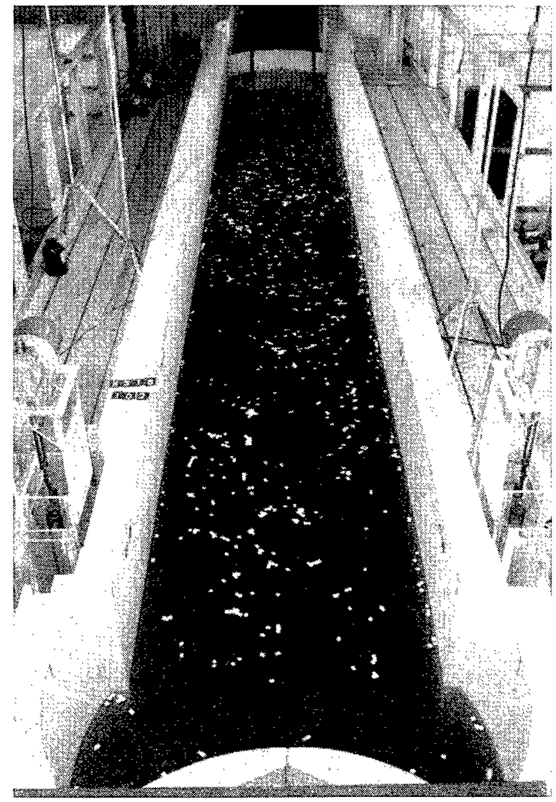
Photo 9. Surface currents in lock chamber during filling operations, H pattern system with type 1 (original) design; 1-min valve time; time exposure 5 sec (prototype) (Continued)



d. 5.0 min after filling started



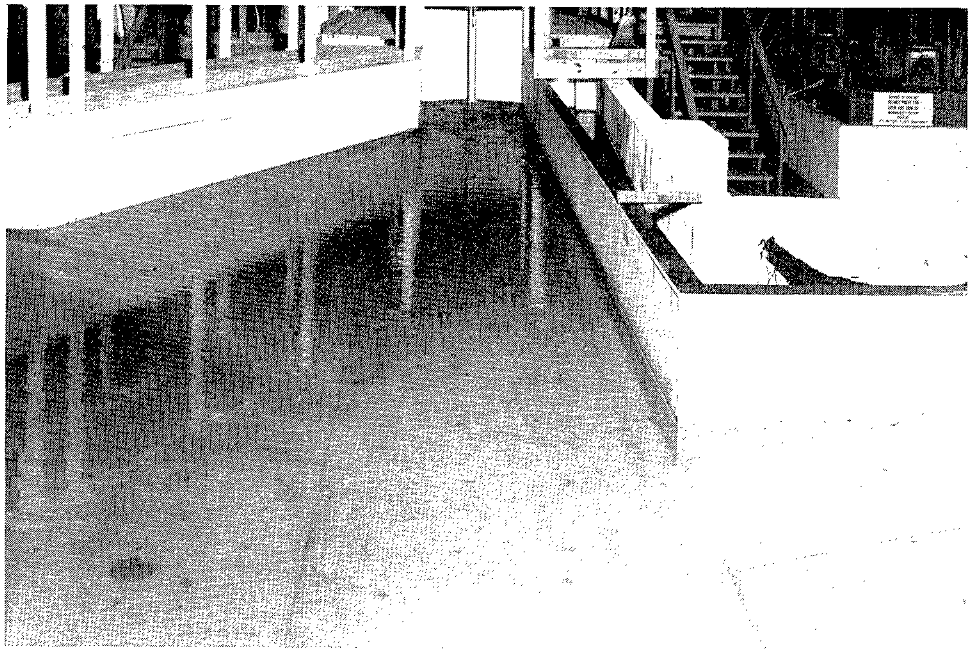
e. 7.0 min after filling started



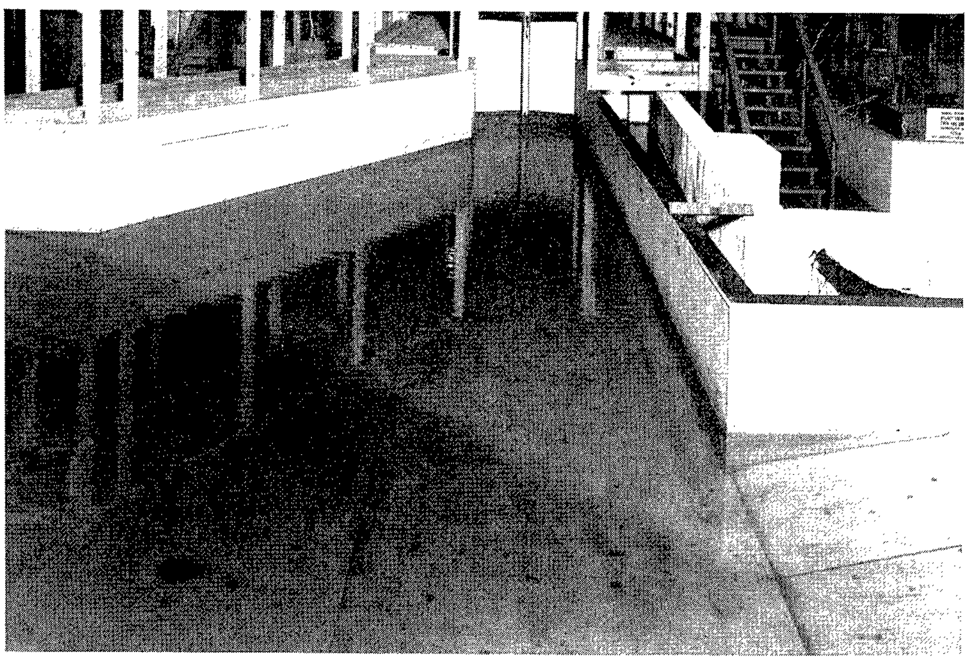
f. 9.0 min after filling started

Photo 9. (Concluded)

142

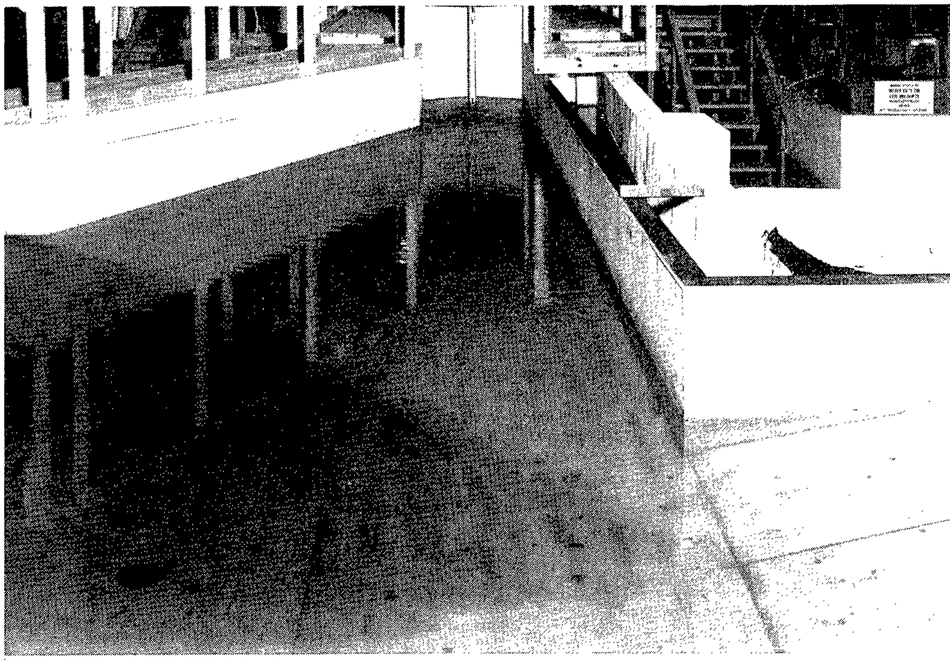


a. Normal 1-min valve emptying operation



b. Single 1-min right valve emptying operation

Photo 10. Flow conditions during peak discharge, H pattern system, type 1 (original) design outlets and approach channel; initial head 69.5 ft (lock chamber); upper pool el 76.5; lower pool el 7.0 (Continued)



c. Single 1-min left valve emptying operation

Photo 10. (Concluded)

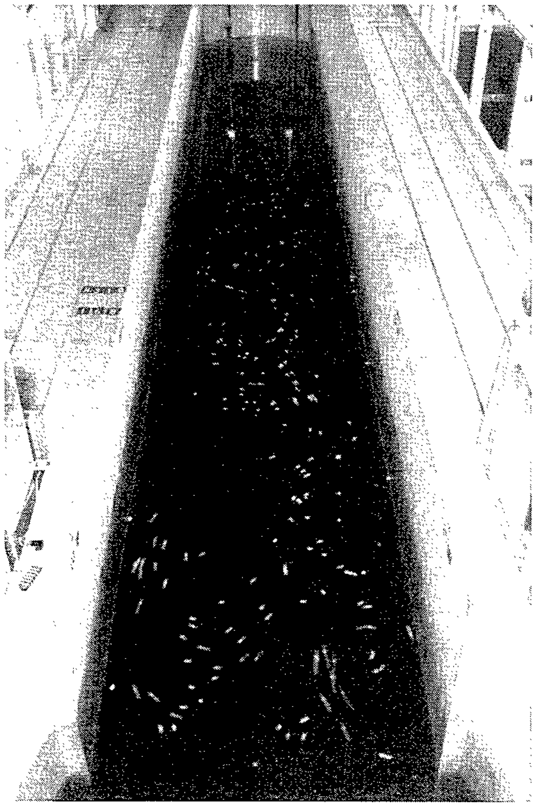
//4/

a. As filling started

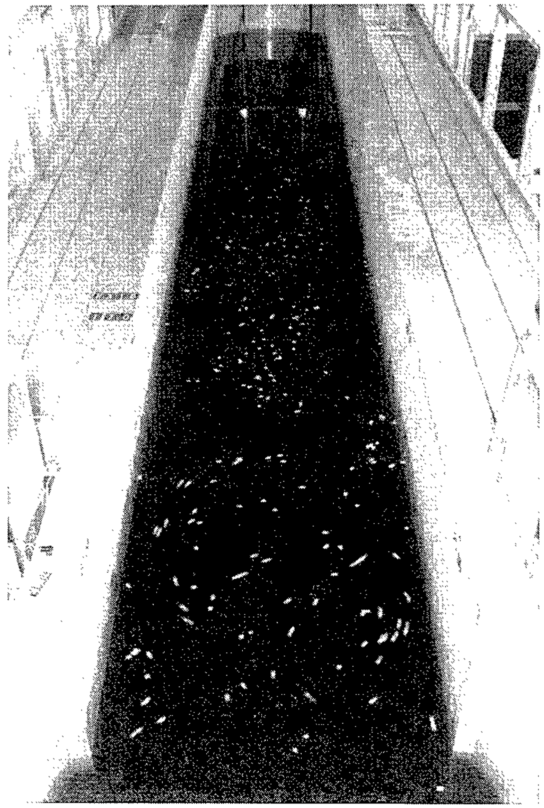
b. 1.5 min after filling started

c. 3.0 min after filling started

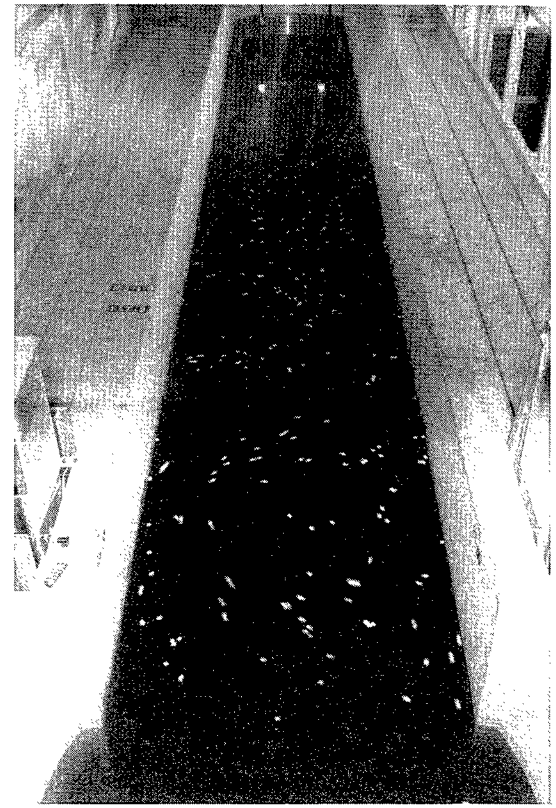
Photo 11. Surface currents in lock chamber during filling operations, H pattern system with type 14 design; 1-min valve time; time exposure 5 sec (prototype) (Continued)



d. 5.0 min after filling started

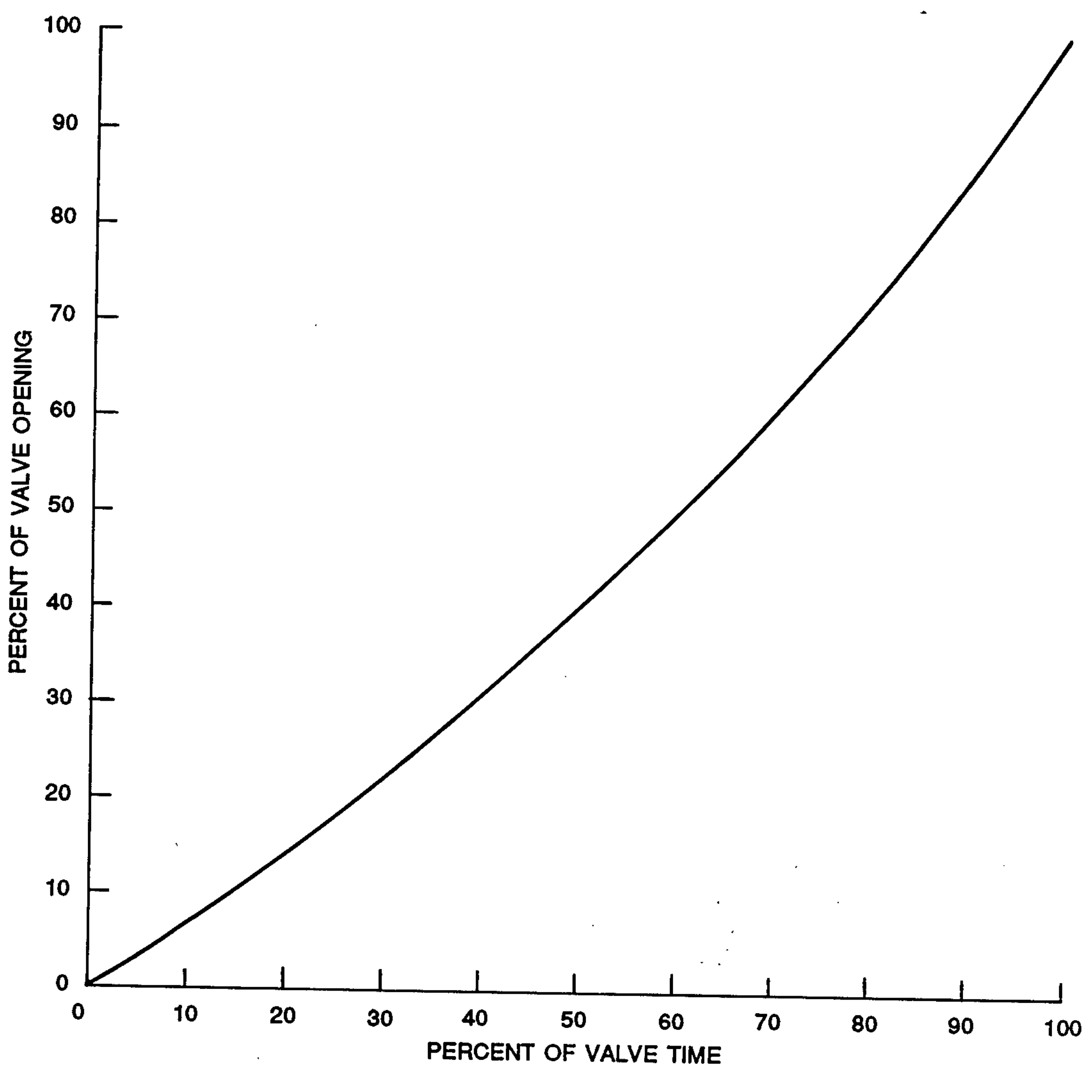


e. 7.0 min after filling started



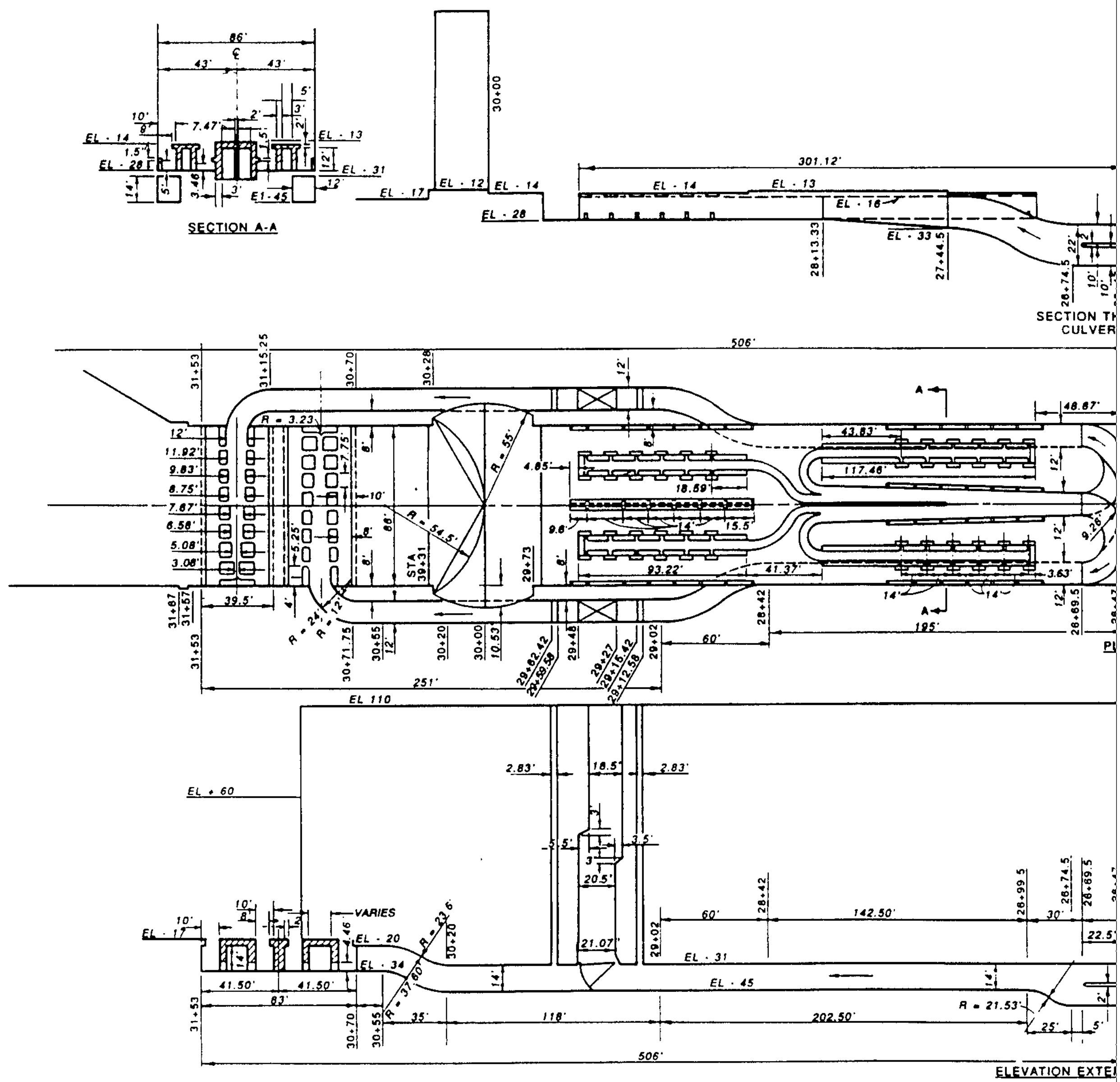
f. 9.0 min after filling started

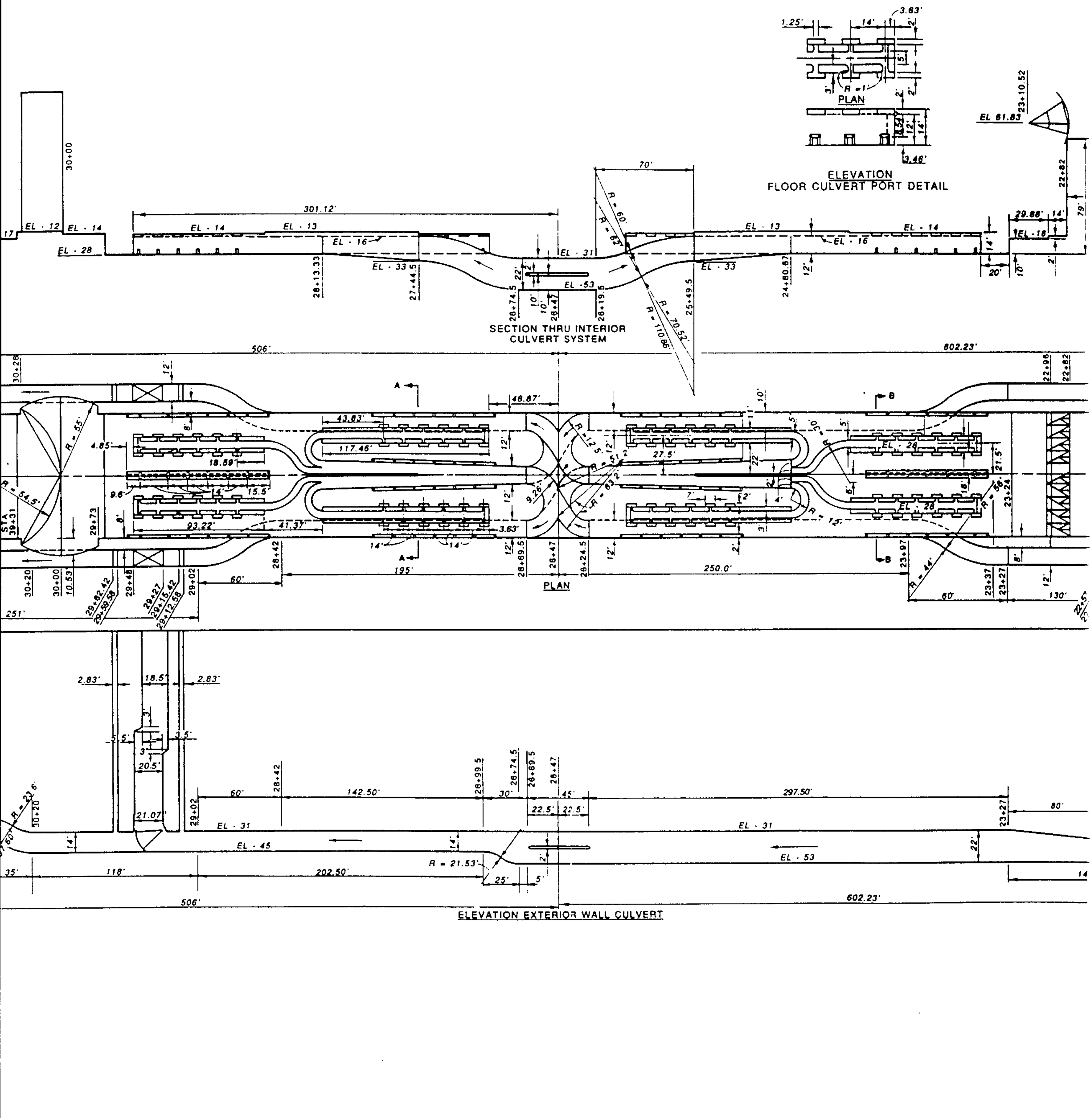
Photo 11. (Concluded)

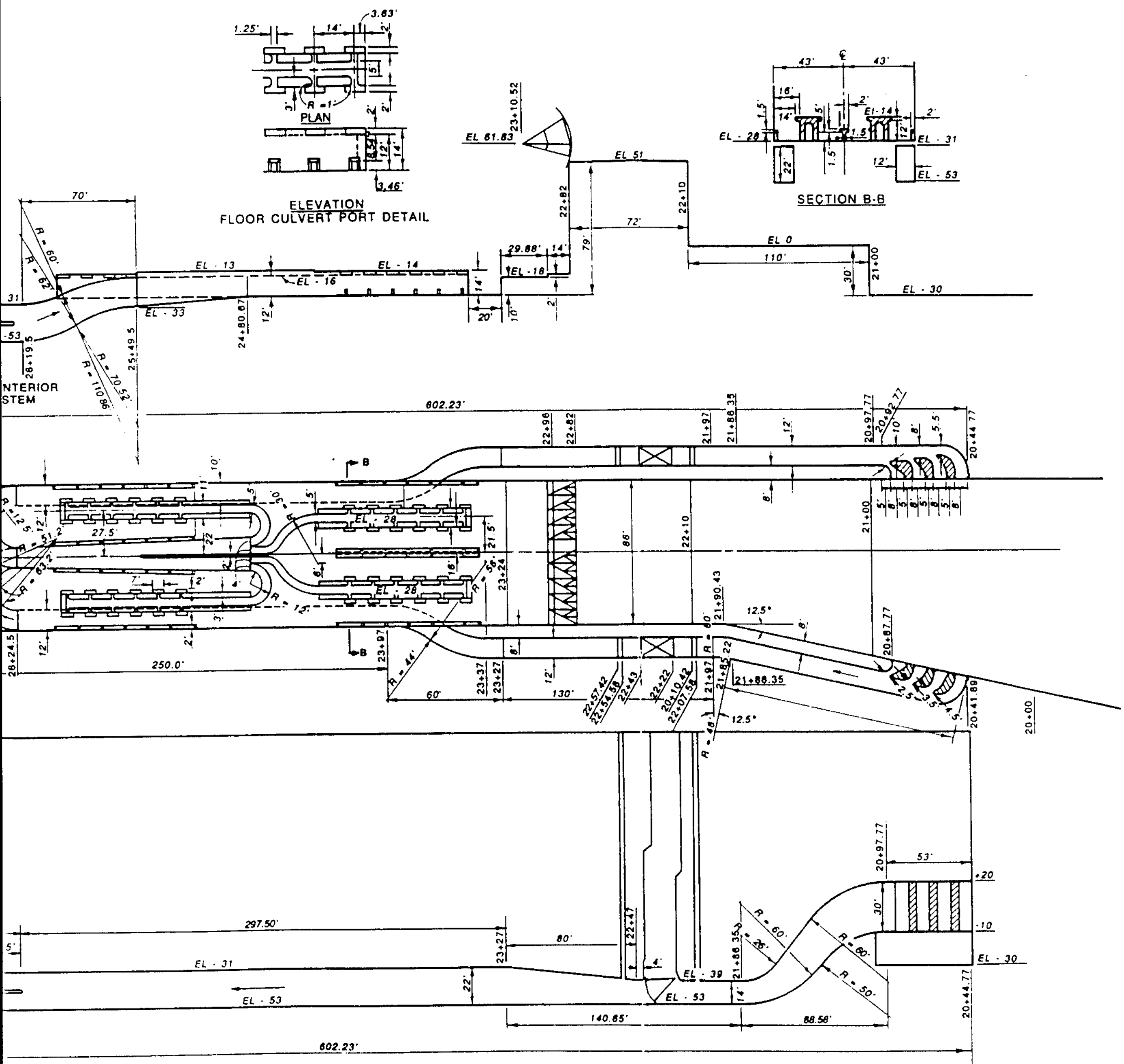


CULVERT VALVE
OPENING SCHEDULE

Plate 1


SECTION A-A
EL - 14
EL - 28
EL - 13
EL - 31
EL - 45
EL - 17
EL - 12
301.12'
EL - 16
EL - 33
506'
251'
195'
EL 110
EL + 60
VARIES
EL - 20
EL - 34
142.50'
202.50'
118'
R = 21.53'

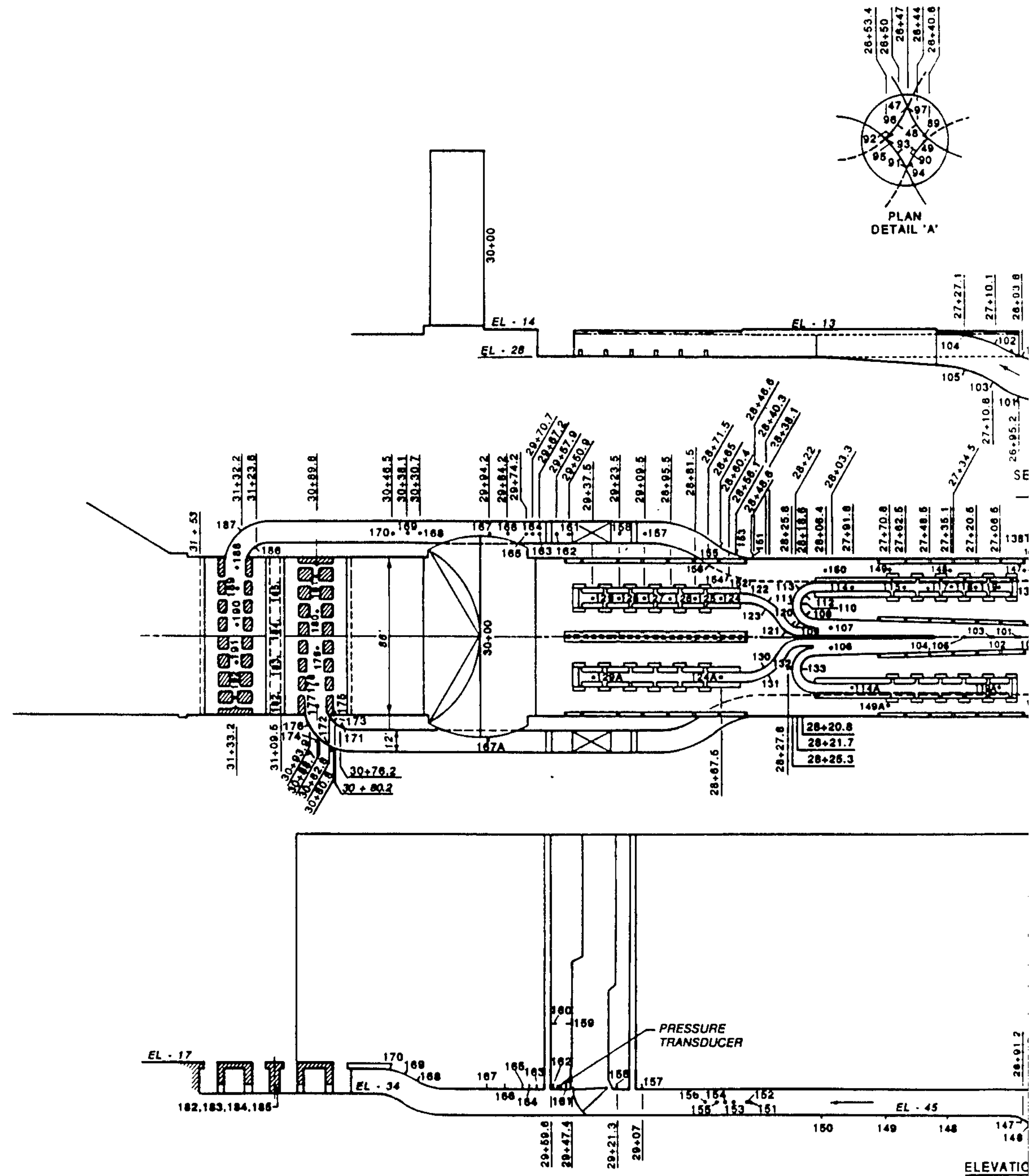

PLAN
ELEVATION
FLOOR CULVERT PORT DETAIL
SECTION THRU INTERIOR
CULVERT SYSTEM
PLAN
ELEVATION EXTERIOR WALL CULVERT

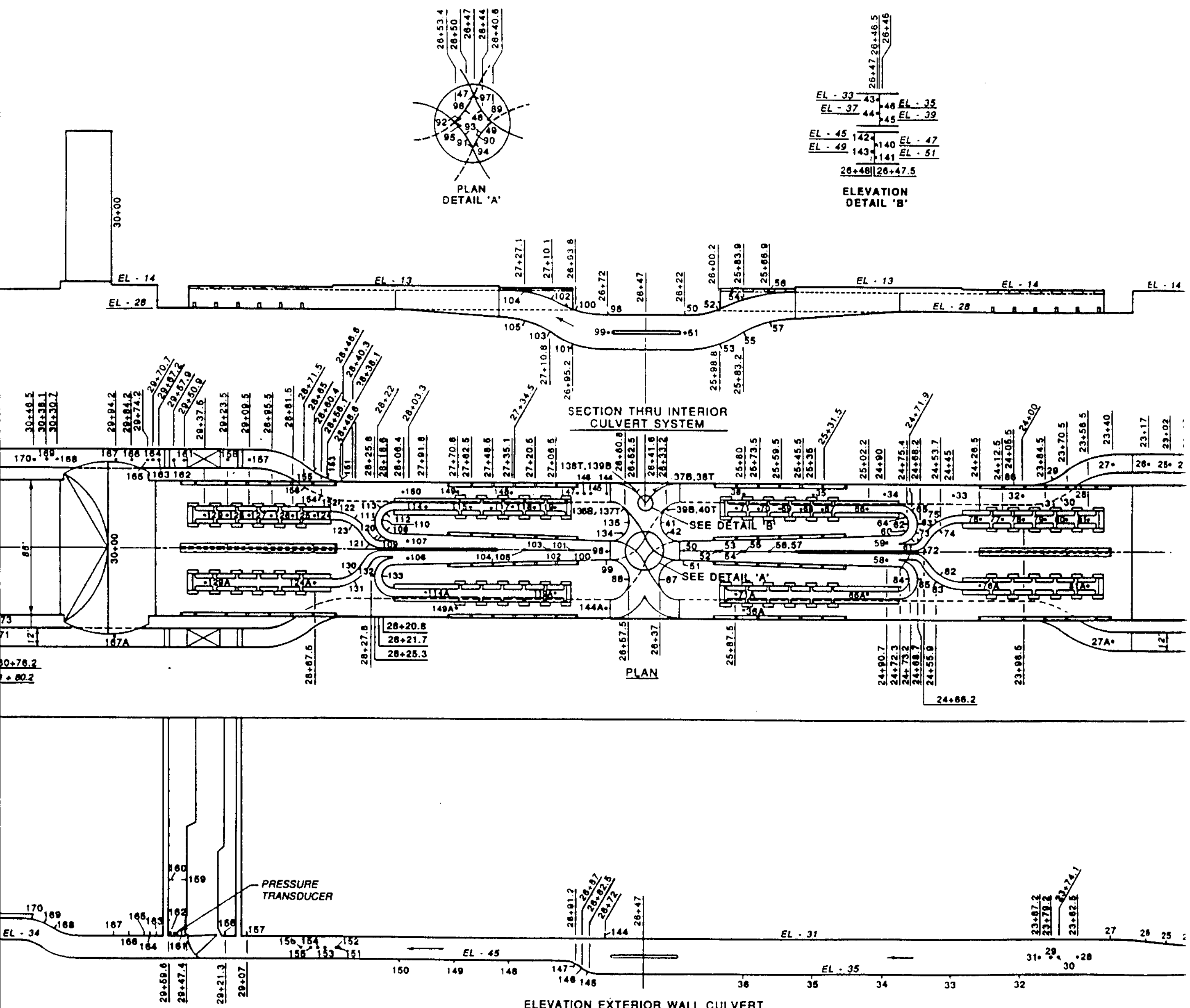


H-H PATTERN SYSTEM

TYPE 1 DESIGN (ORIGINAL)

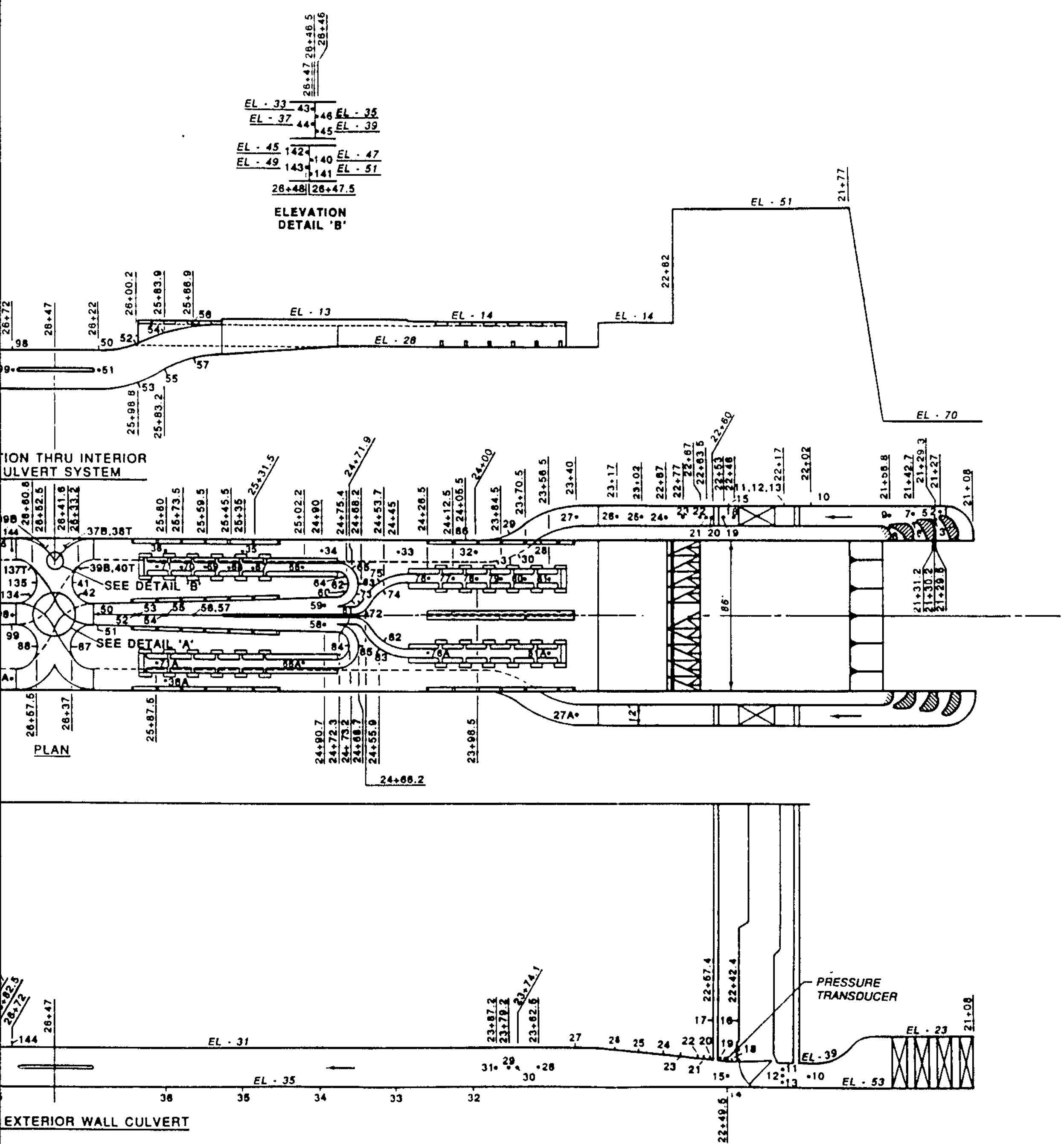
FILLING AND EMPTYING SYSTEM


PLAN
DETAIL 'A'
EL - 14
EL - 13
EL - 28
EL - 17
EL - 34
EL - 45
PRESSURE
TRANSDUCER

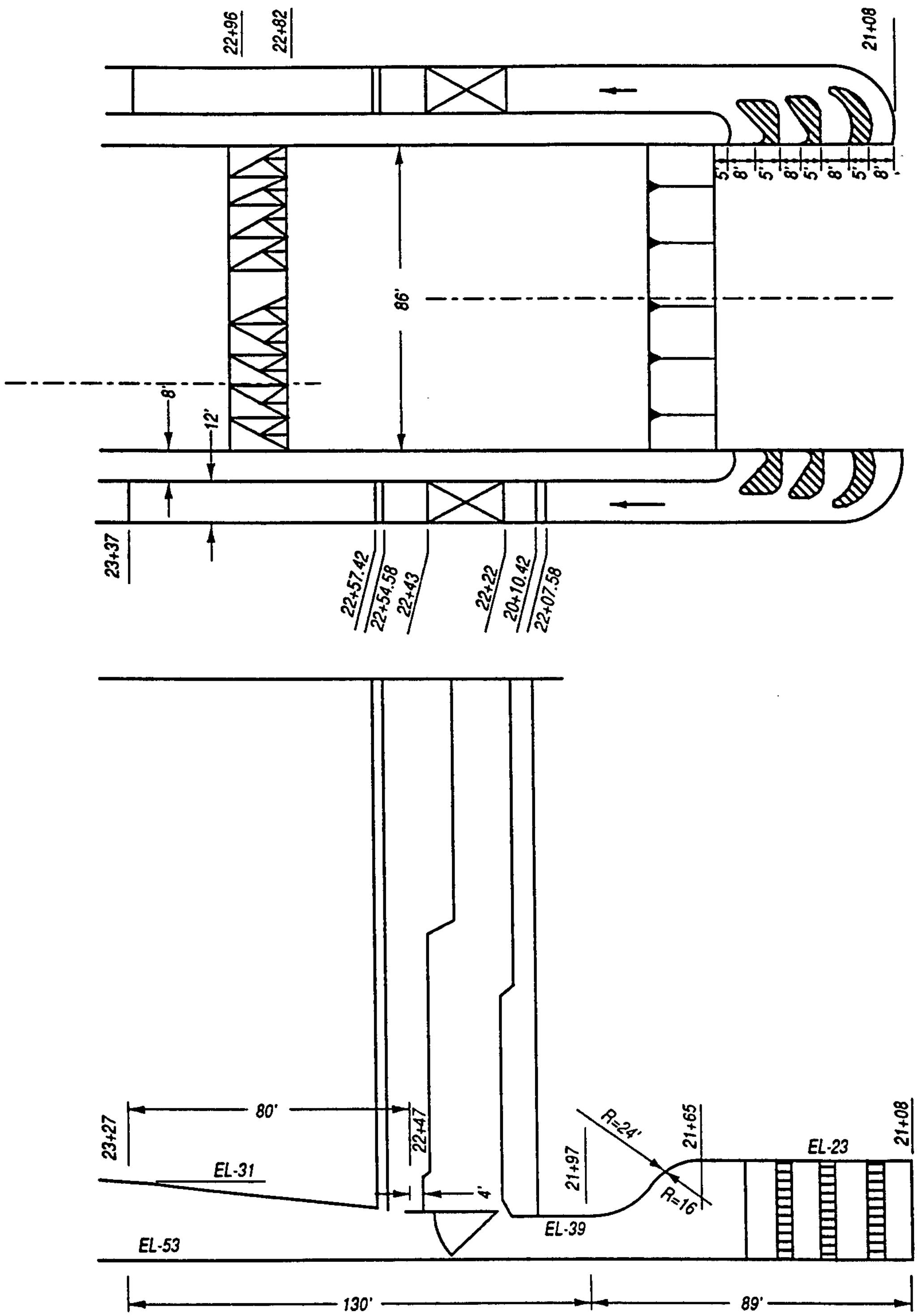

PLAN
DETAIL 'A'
ELEVATION
DETAIL 'B'
EL - 33
EL - 37
EL - 35
EL - 39
EL - 45
EL - 49
EL - 47
EL - 51
EL - 14
EL - 28
EL - 13
SECTION THRU INTERIOR
CULVERT SYSTEM
SEE DETAIL 'B'
SEE DETAIL 'A'
PLAN
PRESSURE
TRANSDUCER
EL - 34
EL - 45
EL - 31
EL - 35
ELEVATION EXTERIOR WALL CULVERT

P

FILLI



H-H PATTERN SYSTEM
PIEZOMETER LOCATIONS
TYPE 2 DESIGN
FILLING AND EMPTYING SYSTEM



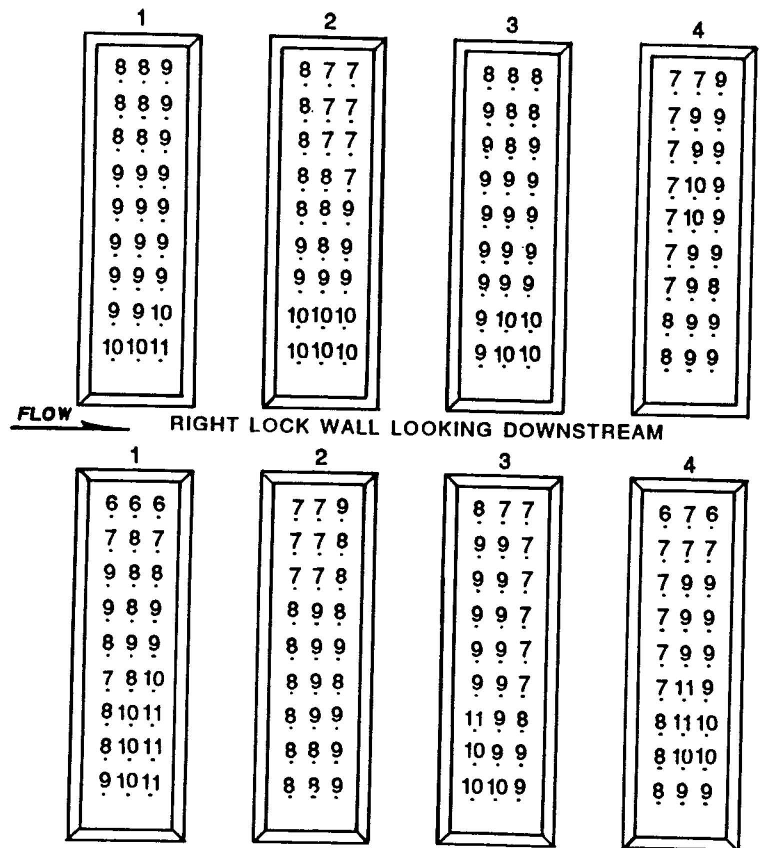
H-H PATTERN SYSTEM

INTAKES

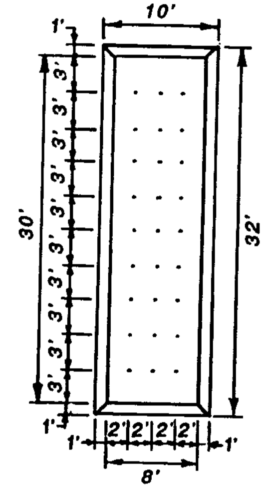
TYPE 2 DESIGN

FILLING AND EMPTYING SYSTEM

Plate 4



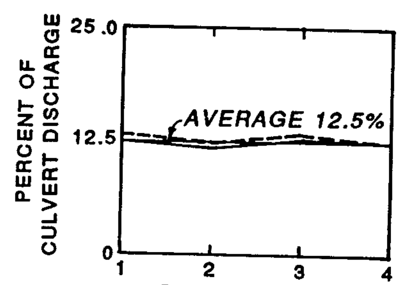
VELOCITIES AT PORT FACE



LOCATION OF PORT VELOCITY MEASUREMENTS

TEST CONDITIONS
TOTAL DISCHARGE 16,400 CFS
UPPER POOL EL 76.5
LOCK CHAMBER EL -7
FILLING VALVES OPEN FULL
UPPER MITER GATES CLOSED
EMPTYING VALVES CLOSED
LOWER MITER GATES OPEN

NOTE: VELOCITIES ARE IN PROTOTYPE FEET PER SECOND AND ARE MEASURED AT WALL FACE OF INTAKE MANIFOLDS.



FLOW DISTRIBUTION

LEGEND

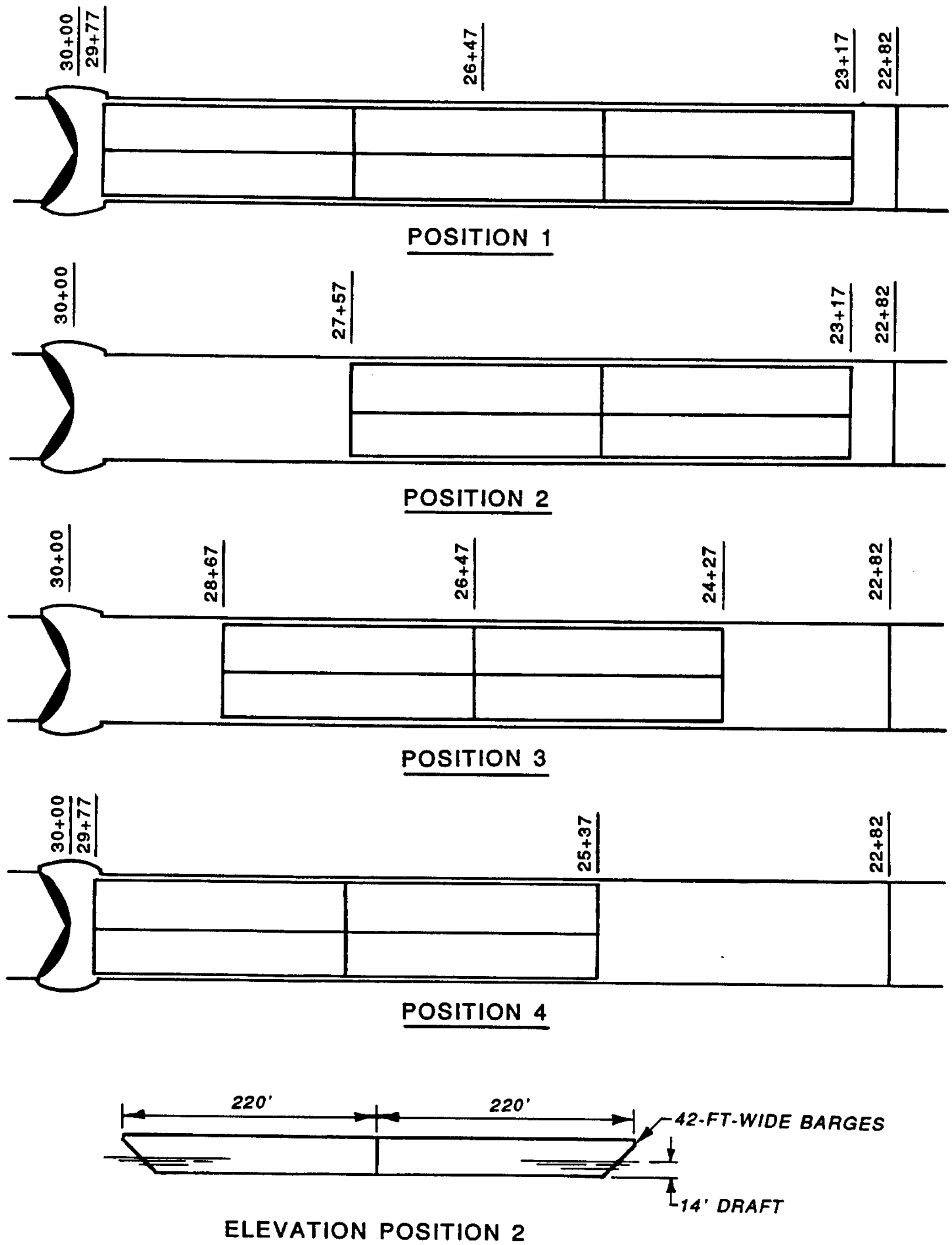
—— LEFT LOCK WALL LOOKING DOWNSTREAM (50.9% OF TOTAL FLOW)

---- RIGHT LOCK WALL LOOKING DOWNSTREAM (49.1% OF TOTAL FLOW)

H-H PATTERN SYSTEM

INTAKE MANIFOLD VELOCITIES AND FLOW DISTRIBUTION

TYPE 4 DESIGN
FILLING AND EMPTYING SYSTEM
STEADY FLOW CONDITIONS

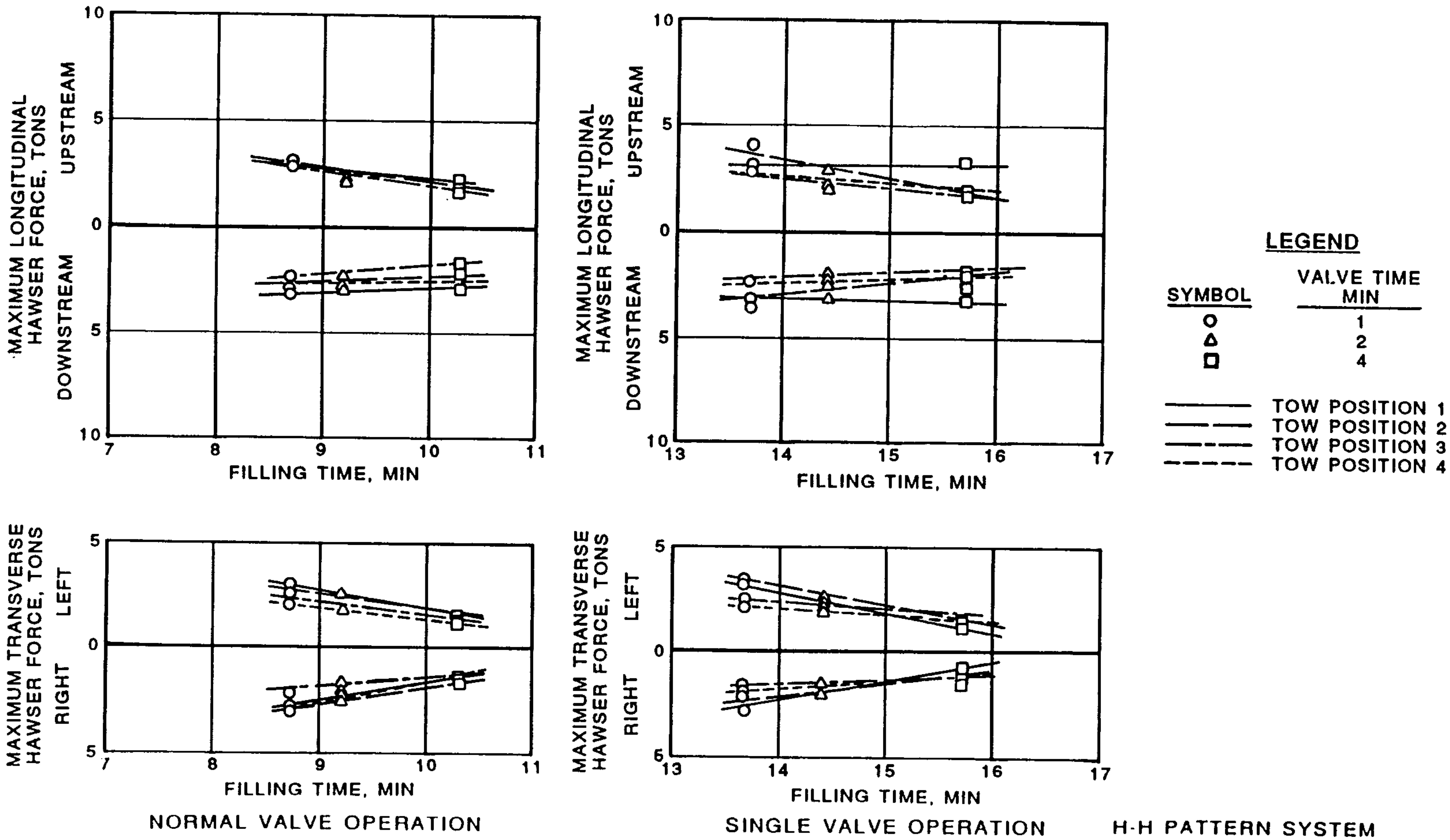


NOTE: STATION 26+47 IS CENTER LINE OF CENTRAL DISTRIBUTION SYSTEM

H-H PATTERN SYSTEM

BARGE POSITIONS AND DETAILS

Plate 6

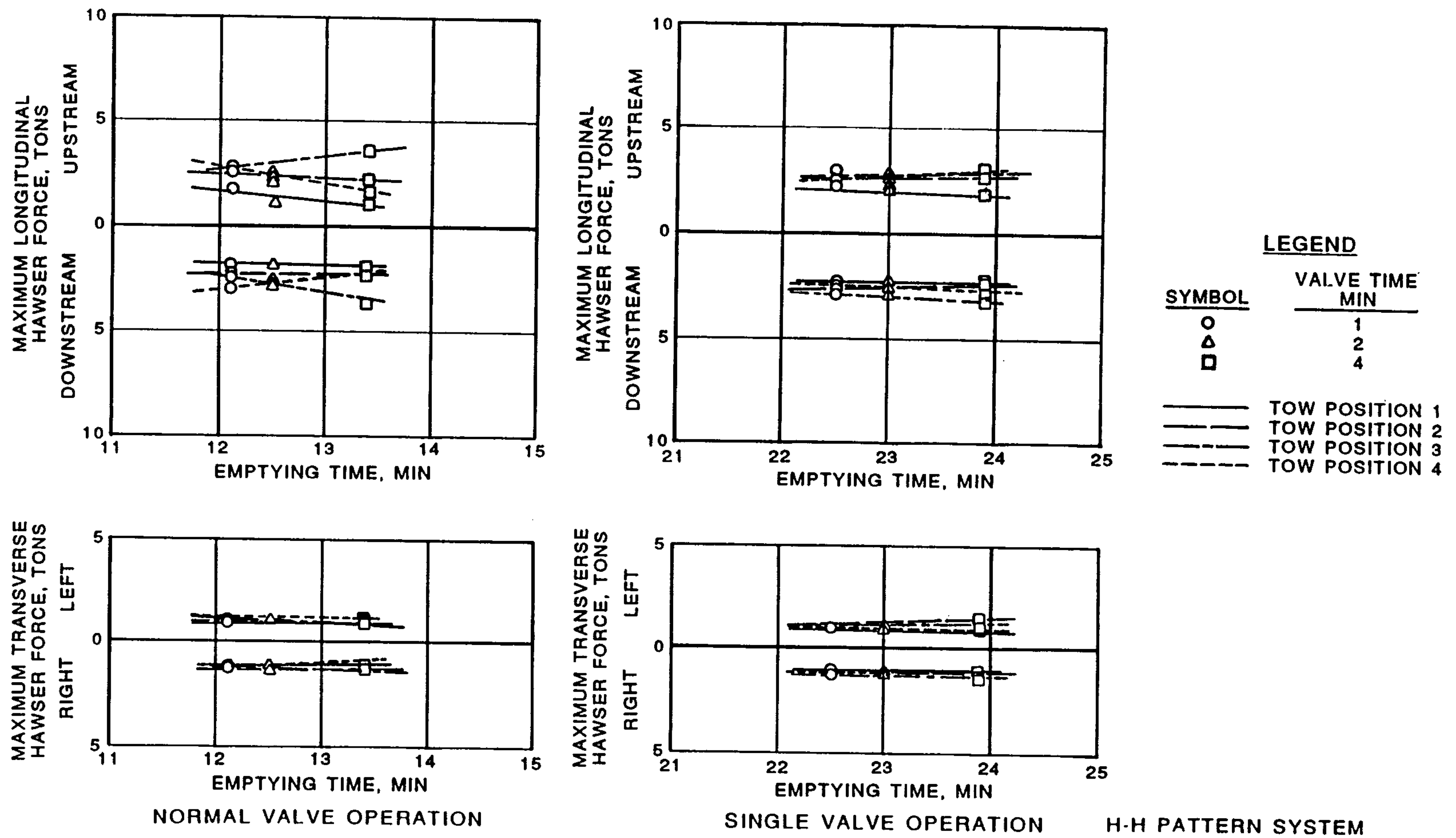


H-H PATTERN SYSTEM

MAXIMUM HAWSER FORCES DURING FILLING OPERATIONS

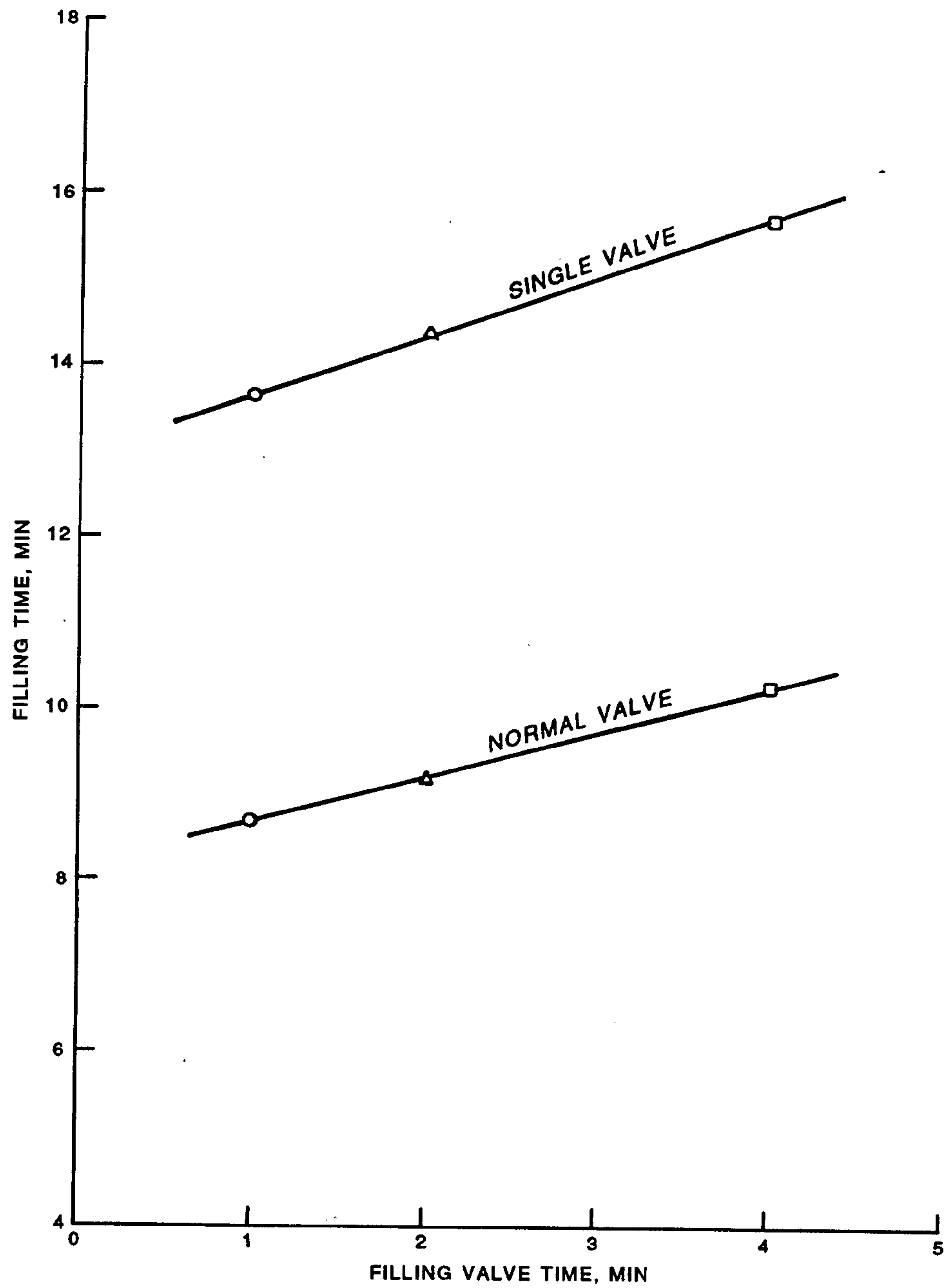
TYPE 2 DESIGN

69.5' LIFT



H-H PATTERN SYSTEM

MAXIMUM HAWSER FORCES DURING EMPTYING OPERATIONS
TYPE 2 DESIGN
69.5' LIFT



H-H PATTERN SYSTEM
FILLING TIME
VERSUS
FILLING VALVE TIME
TYPE 2 DESIGN

Plate 9

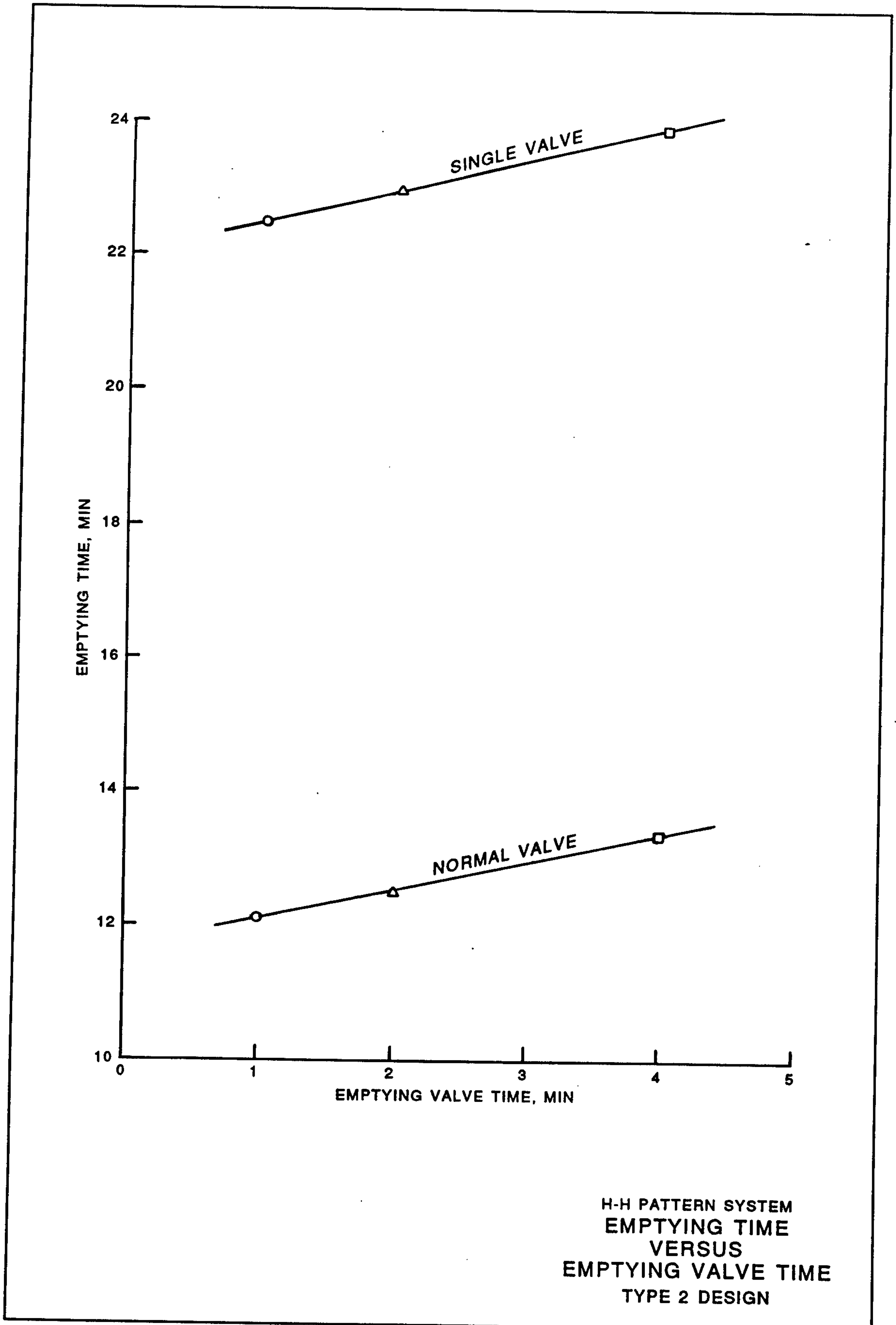
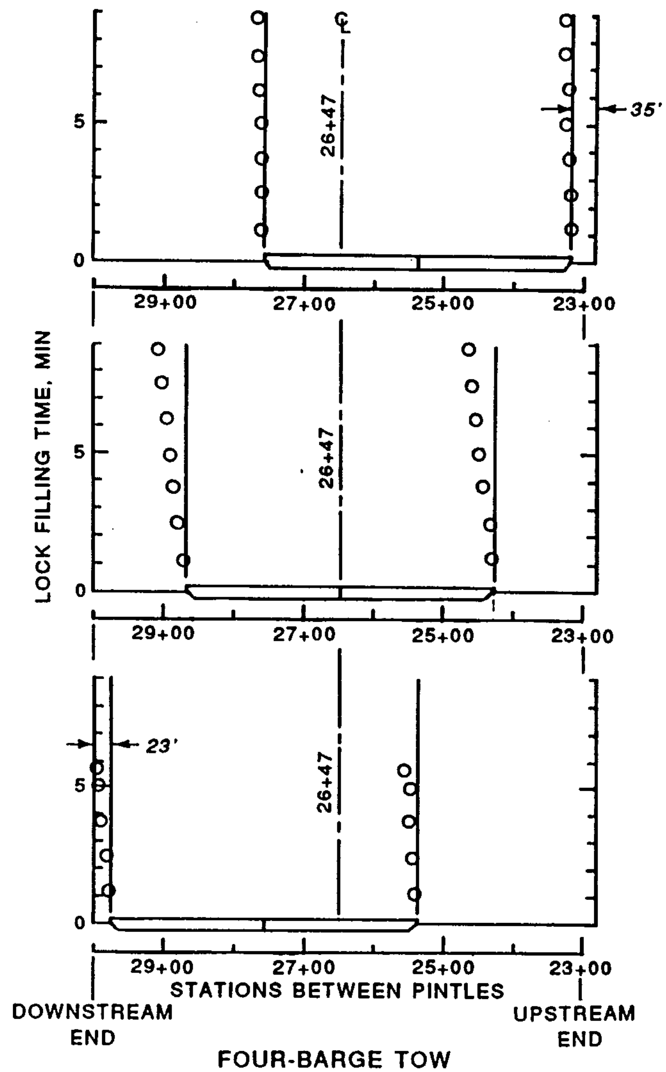
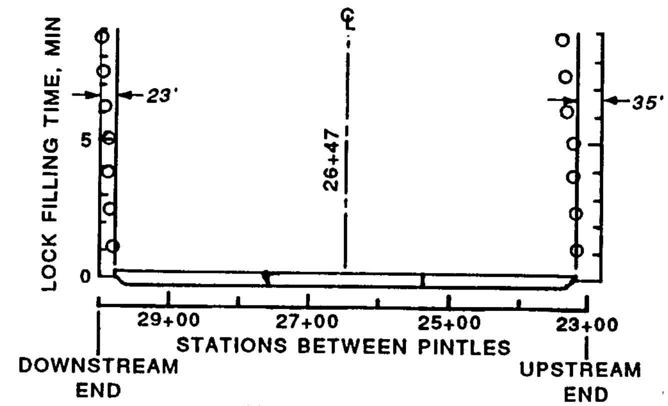

SINGLE VALVE
NORMAL VALVE
EMPTYING TIME, MIN
EMPTYING VALVE TIME, MIN
24
22
20
18
16
14
12
10
0
1
2
3
4
5
H-H PATTERN SYSTEM
EMPTYING TIME
VERSUS
EMPTYING VALVE TIME
TYPE 2 DESIGN

Plate 10



FOUR-BARGE TOW



SIX-BARGE TOW

H-H PATTERN SYSTEM

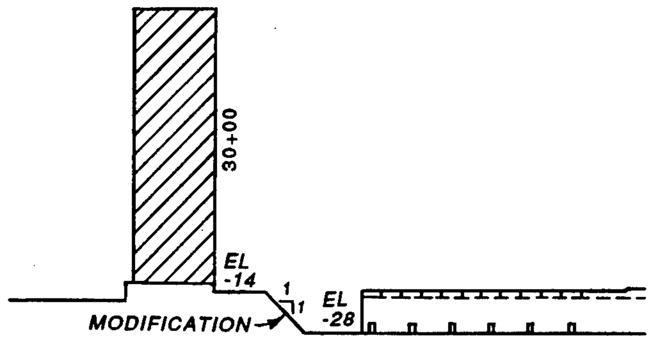
TYPICAL FREE TOW MOVEMENT DURING FILLING OPERATIONS

TYPE 2 DESIGN

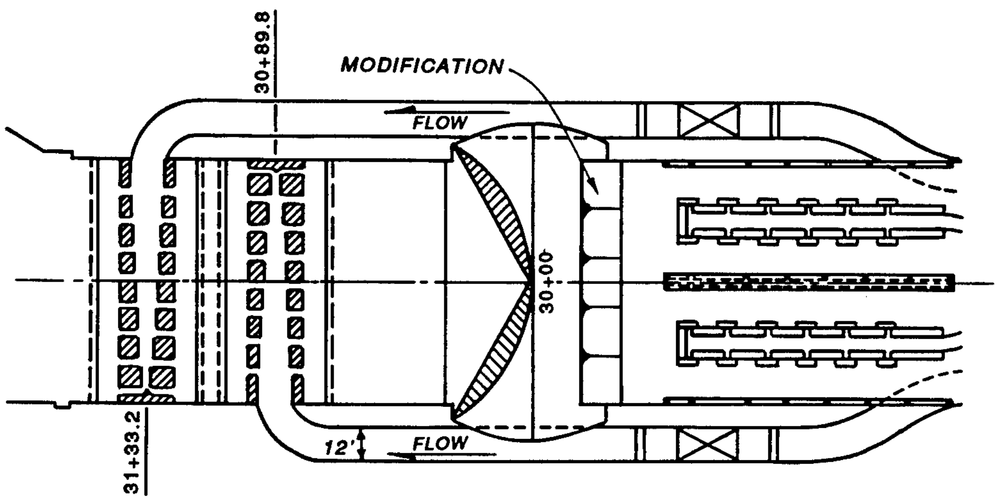
1-MIN NORMAL VALVE OPERATION

U.P. EL 76.5, L.P. EL 7.0

161



ELEVATION

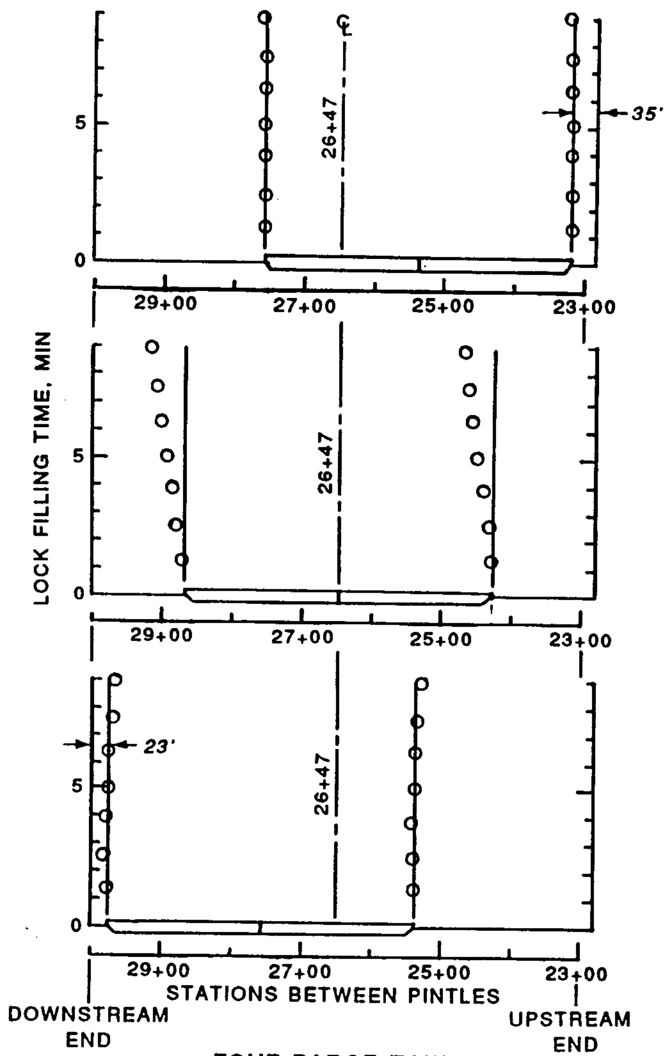


PLAN

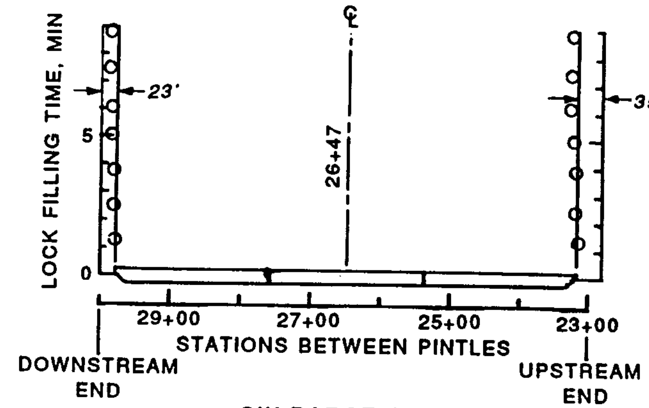
H-H PATTERN SYSTEM

FILLING AND EMPTYING SYSTEM

TYPE 4 DESIGN



FOUR-BARGE TOW



SIX-BARGE TOW

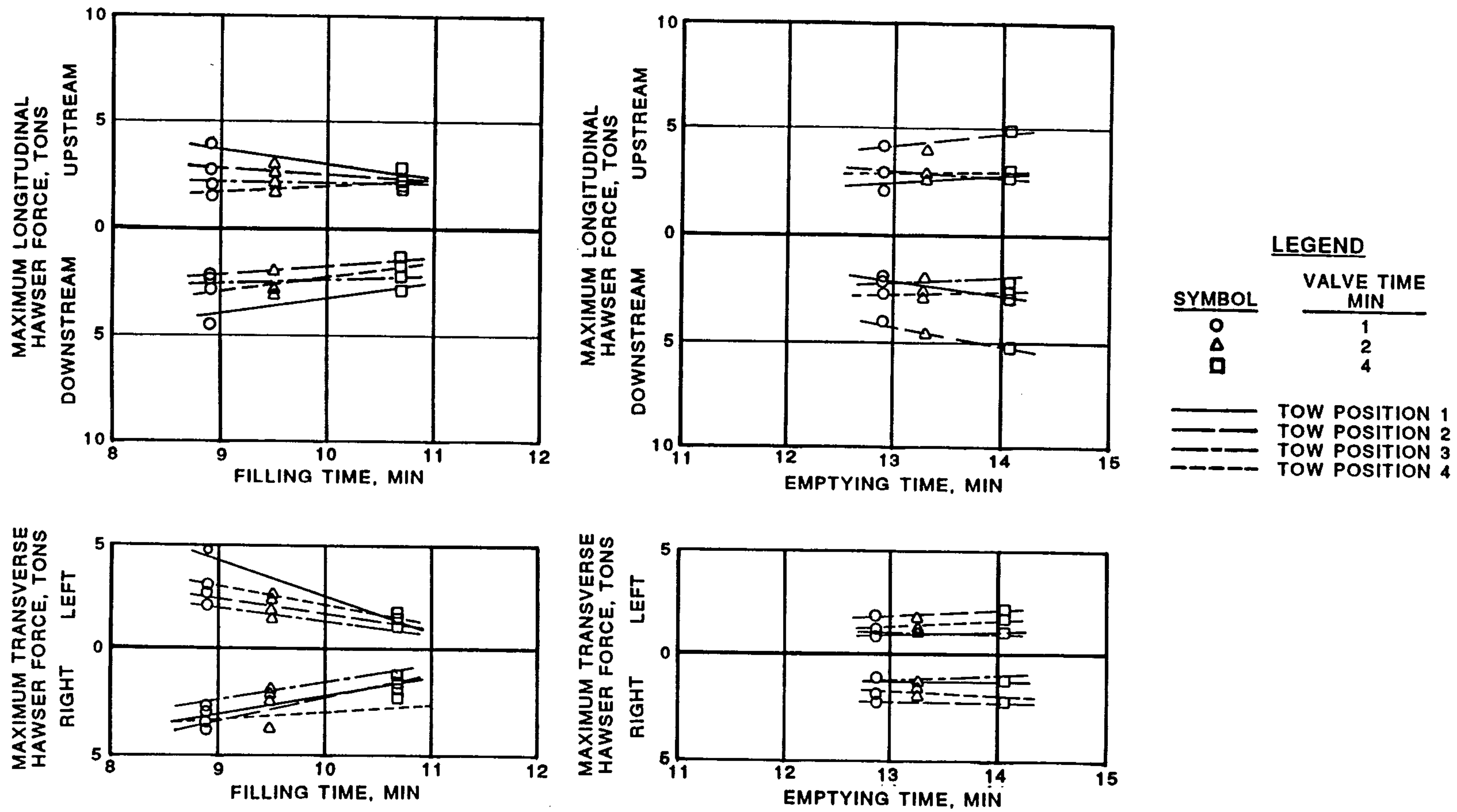
H-H PATTERN SYSTEM

TYPICAL FREE TOW MOVEMENT DURING FILLING OPERATIONS

TYPE 4 DESIGN

1-MIN NORMAL VALVE OPERATION

U.P. EL 76.5, L.P. EL 7.0

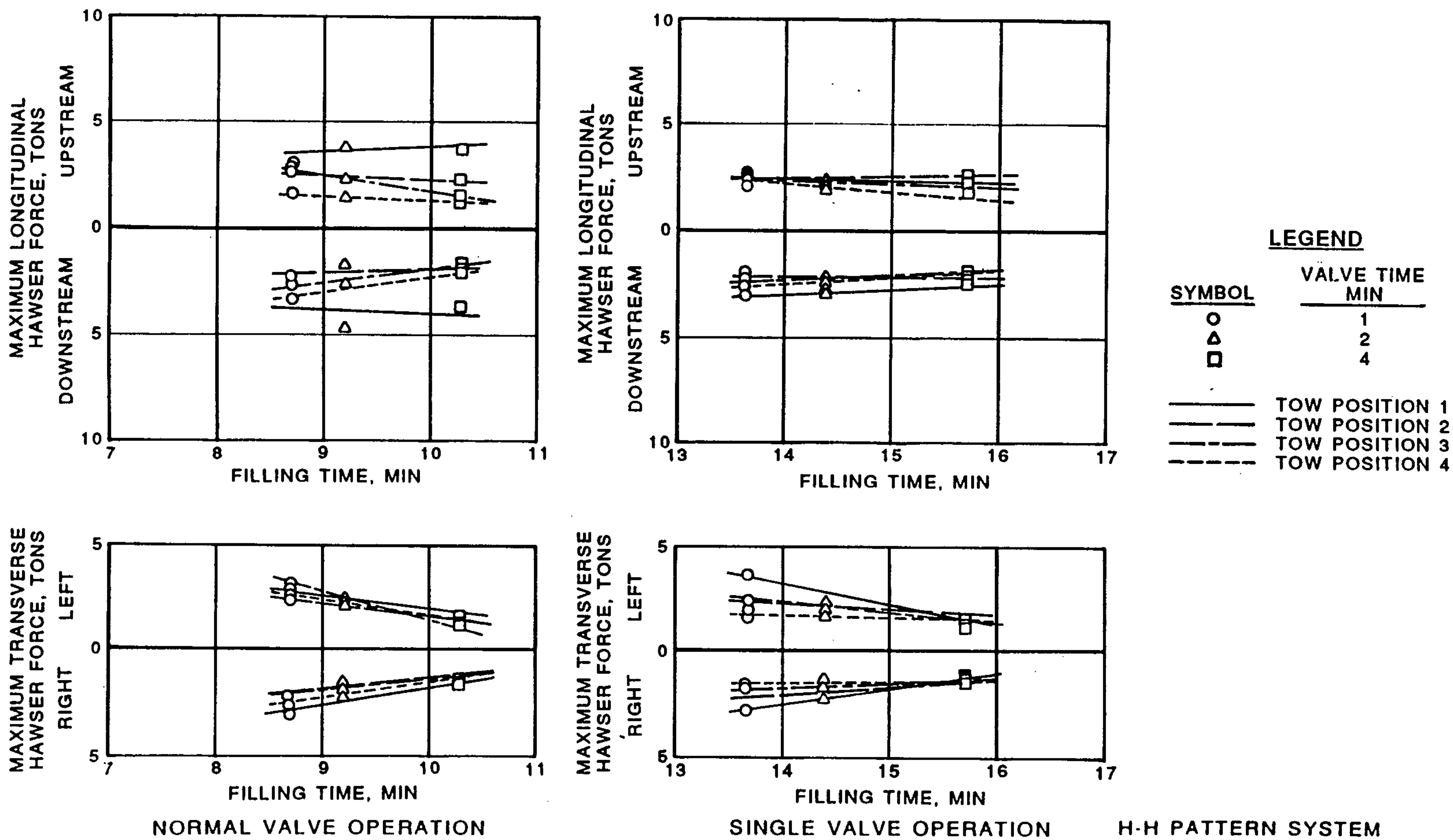


H-H PATTERN SYSTEM

MAXIMUM HAWSER FORCES
NORMAL VALVE OPERATIONS

TYPE 4 DESIGN

U.P. EL 82.5 L.P. EL 7

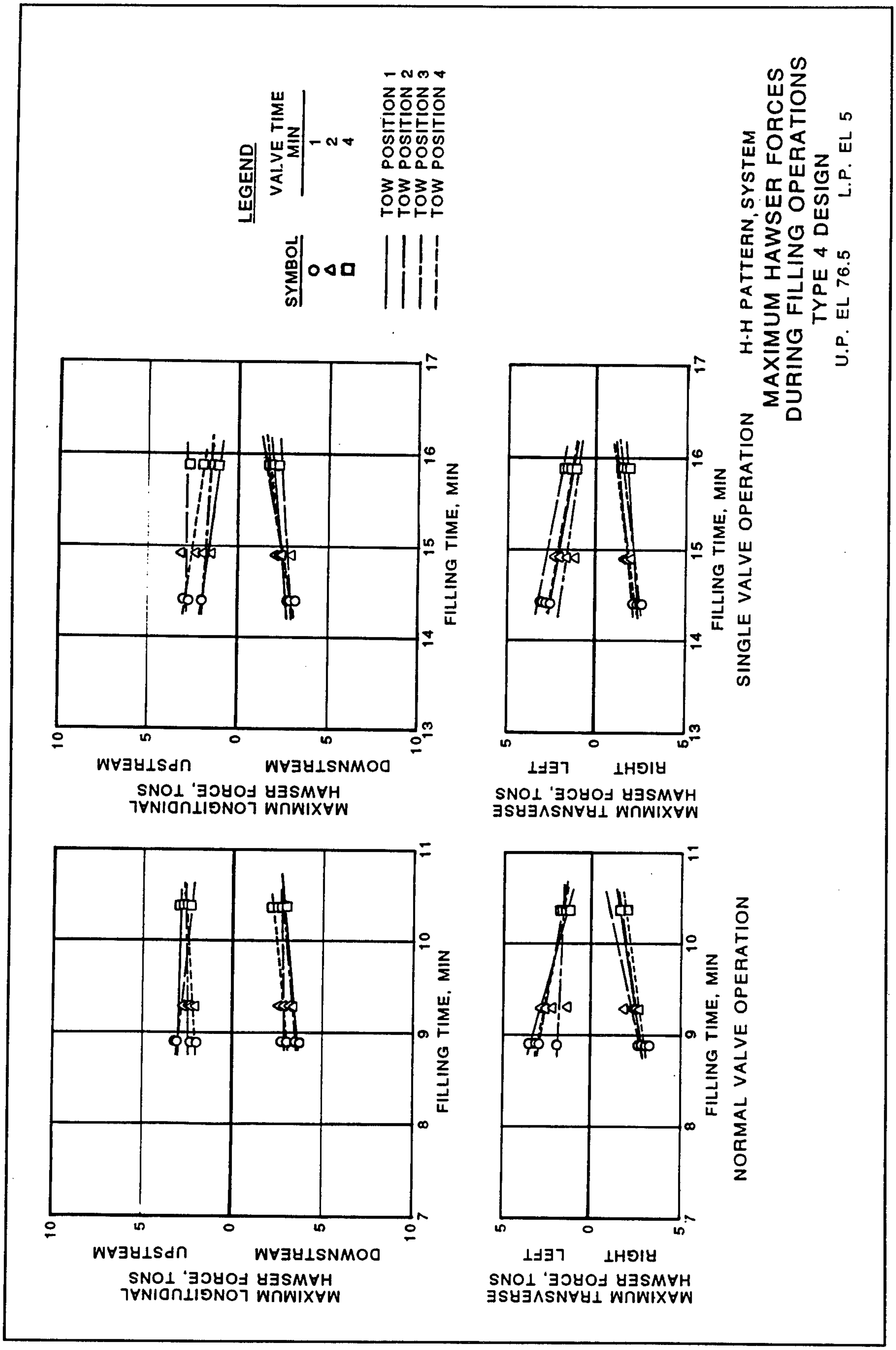


H-H PATTERN SYSTEM

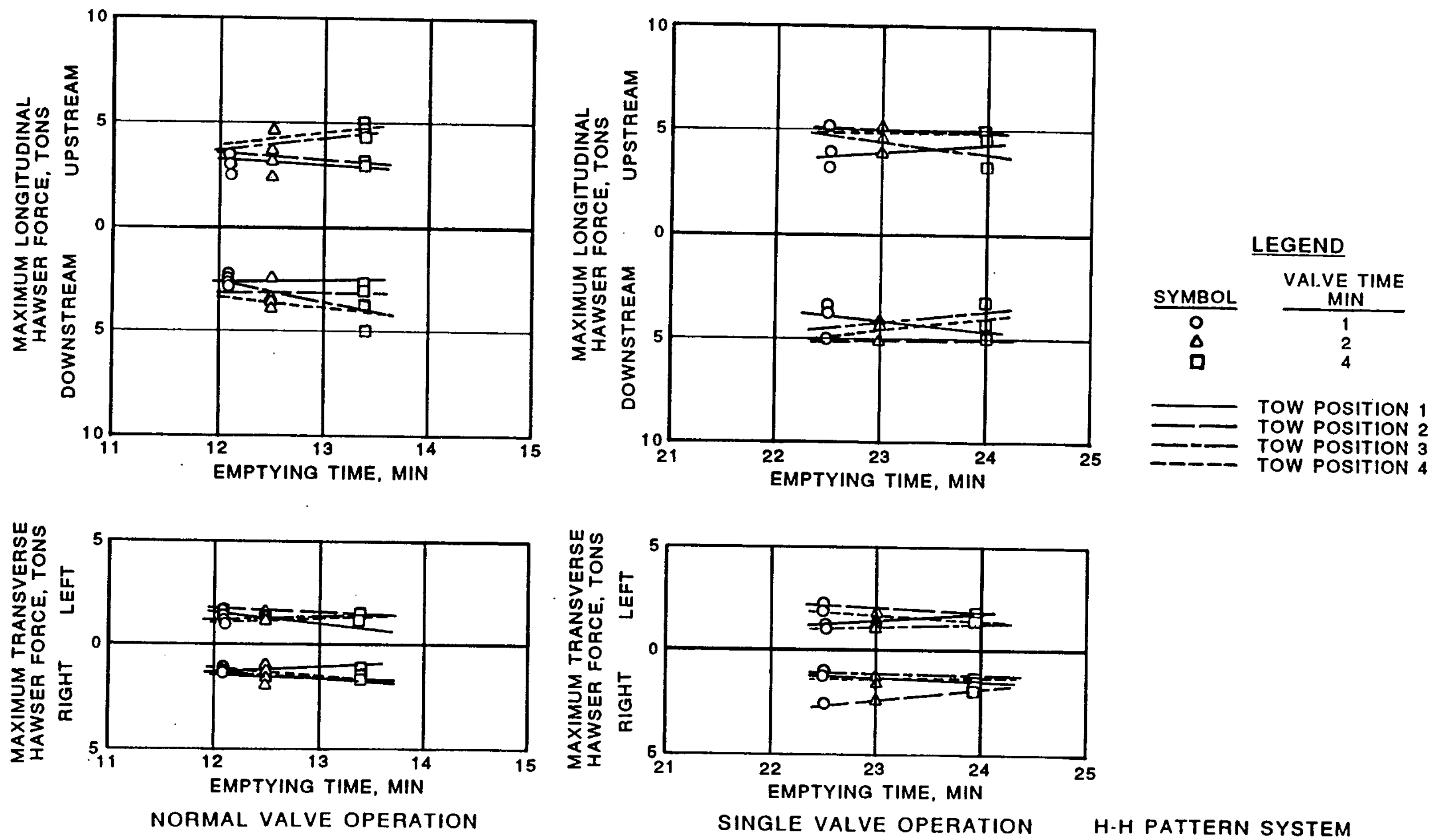
MAXIMUM HAWSER FORCES DURING FILLING OPERATIONS

TYPE 4 DESIGN

U.P. EL 76.5 L.P. EL 7



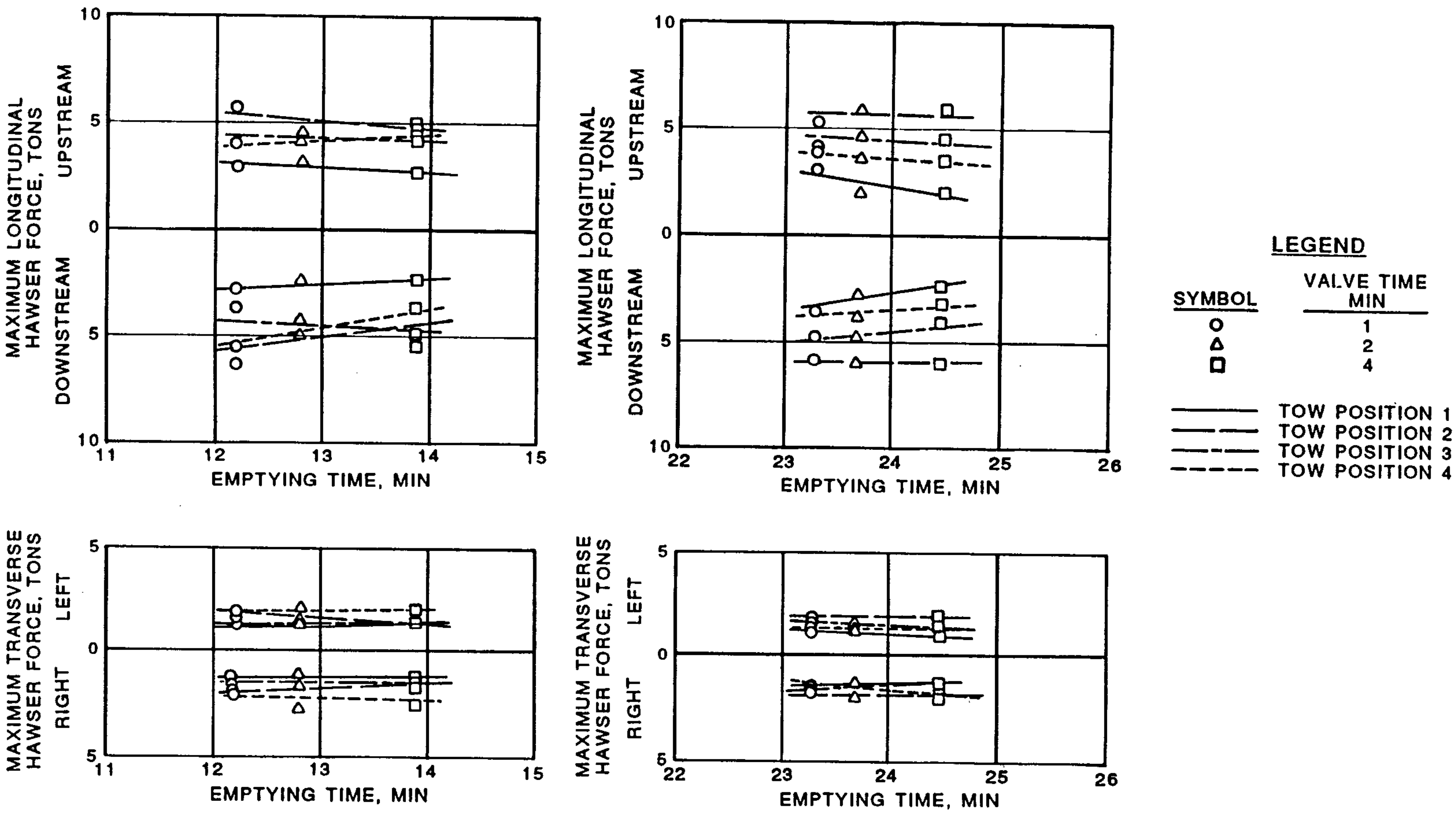
H-H PATTERN, SYSTEM
MAXIMUM HAWSER FORCES
DURING FILLING OPERATIONS
TYPE 4 DESIGN
U.P. EL 76.5 L.P. EL 5



H-H PATTERN SYSTEM

MAXIMUM HAWSER FORCES
DURING EMPTYING OPERATIONS
TYPE 4 DESIGN

U.P. EL 76.5   L.P. EL 7



NORMAL VALVE OPERATION

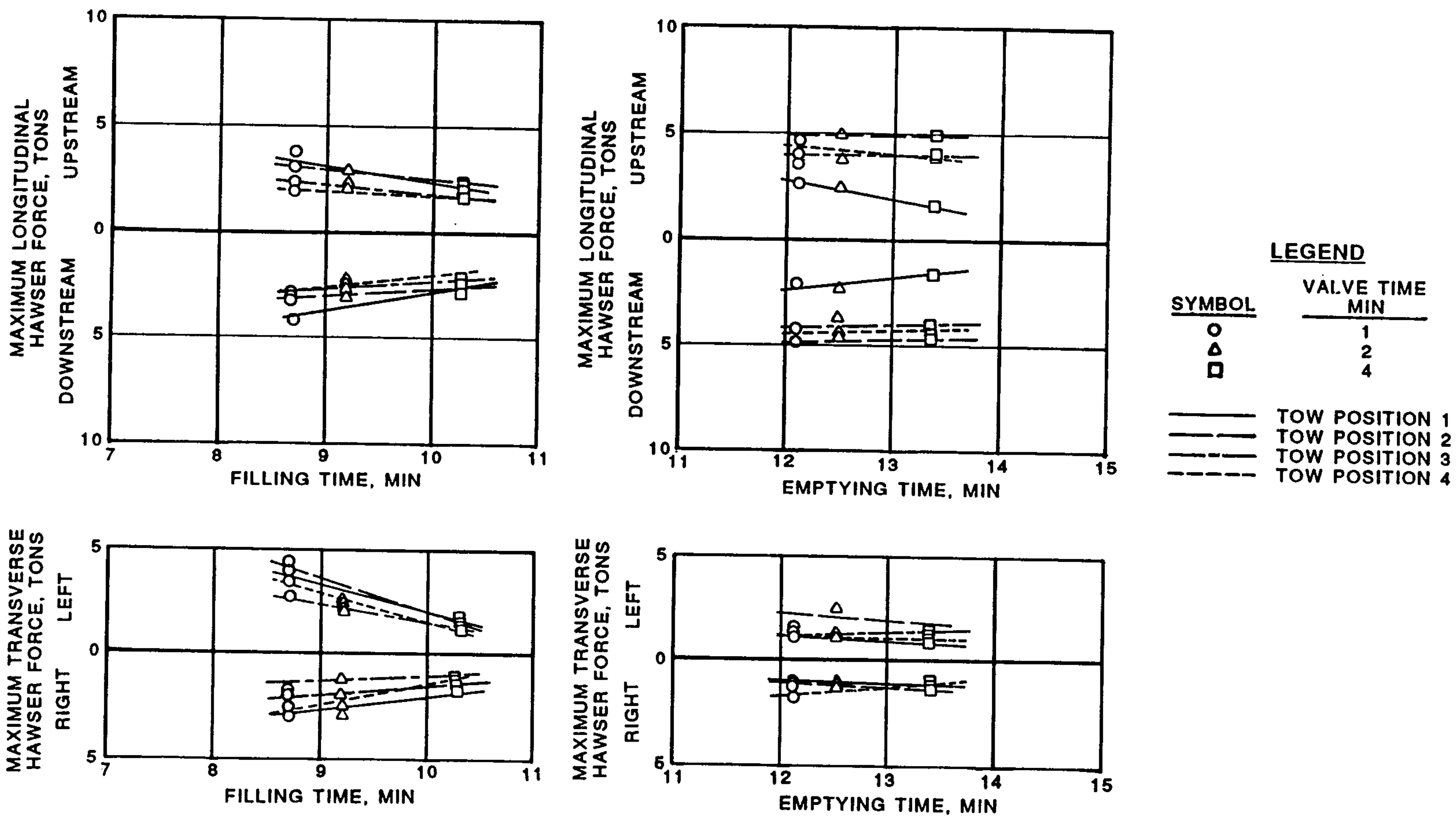
SINGLE VALVE OPERATION

H-H PATTERN SYSTEM

MAXIMUM HAWSER FORCES DURING EMPTYING OPERATIONS

TYPE 4 DESIGN

U.P. EL 76.5 L.P. EL 5

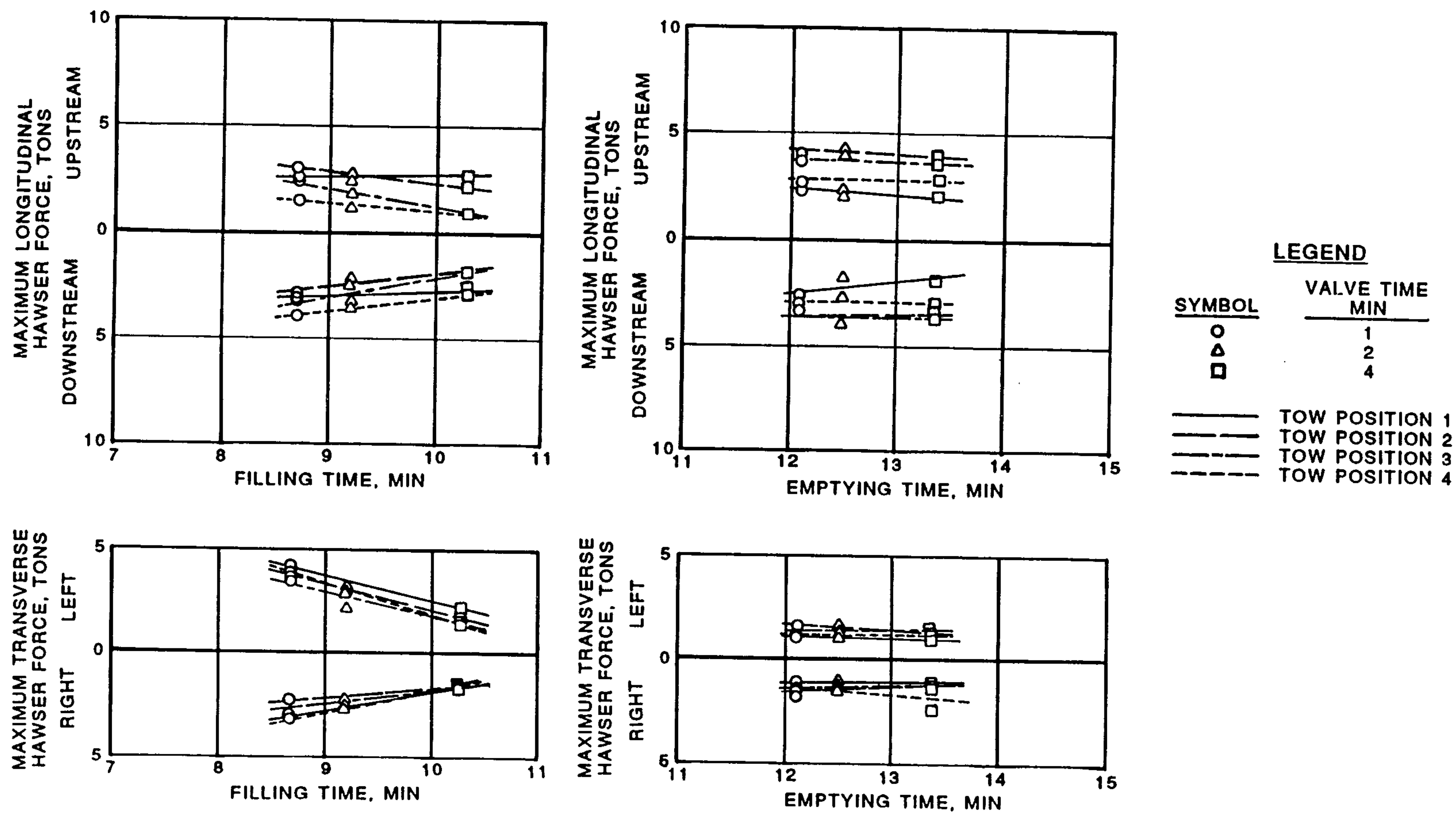


H-H PATTERN SYSTEM

MAXIMUM HAWSER FORCES
NORMAL VALVE OPERATIONS

TYPE 4 DESIGN

U.P. EL 74.5 L.P. EL 5

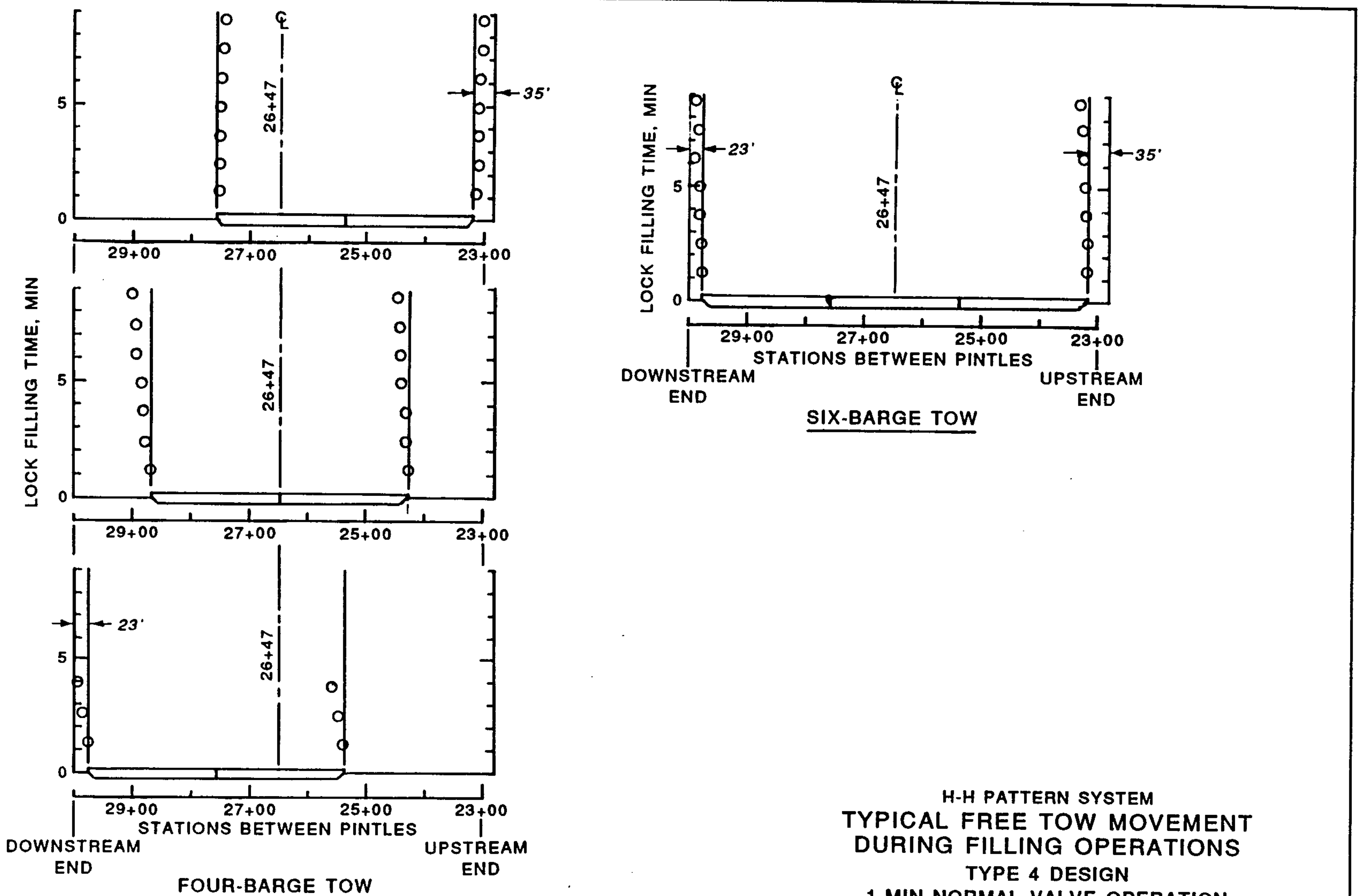


H-H PATTERN SYSTEM

MAXIMUM HAWSER FORCES
NORMAL VALVE OPERATIONS

TYPE 4 DESIGN

U.P. EL 72.5 L.P. EL 3



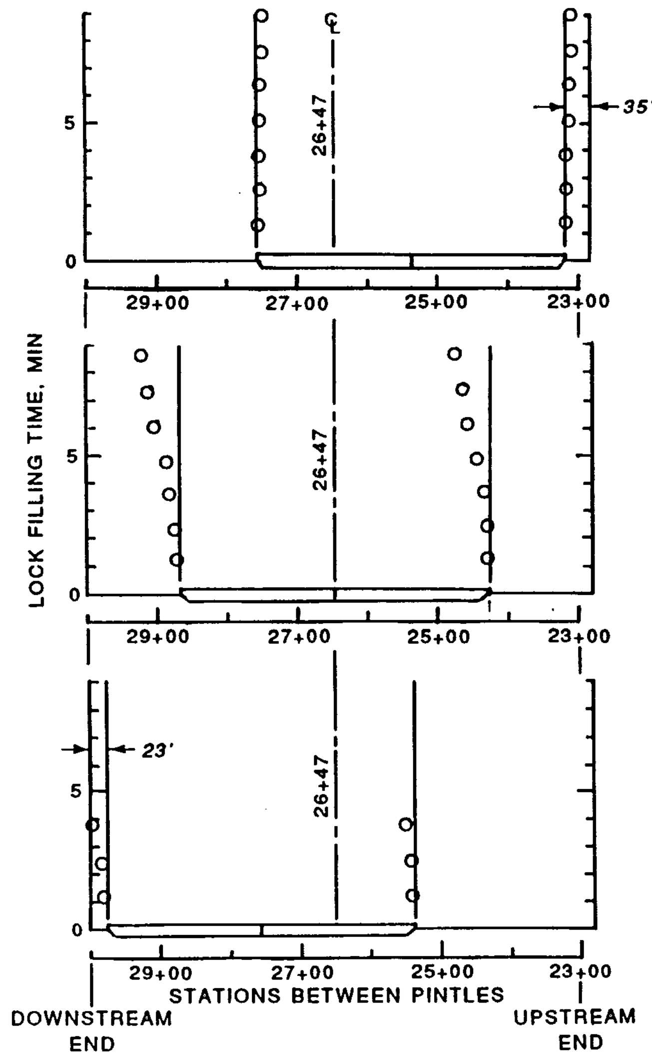
H-H PATTERN SYSTEM

TYPICAL FREE TOW MOVEMENT DURING FILLING OPERATIONS

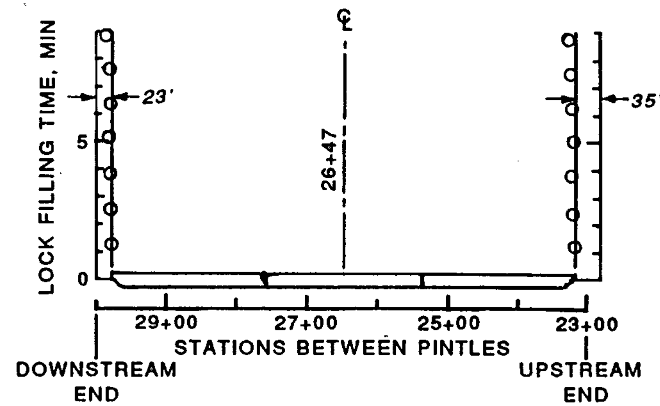
TYPE 4 DESIGN

1-MIN NORMAL VALVE OPERATION

U.P. EL 76.5, L.P. EL 5.0



FOUR-BARGE TOW



SIX-BARGE TOW

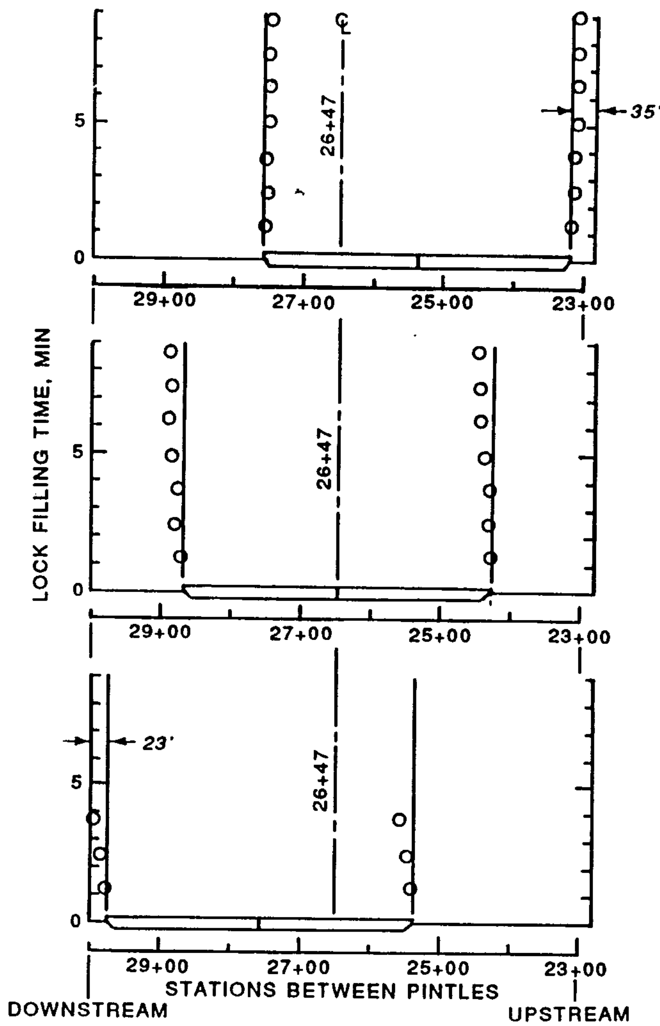
H-H PATTERN SYSTEM

TYPICAL FREE TOW, MOVEMENT DURING FILLING OPERATIONS

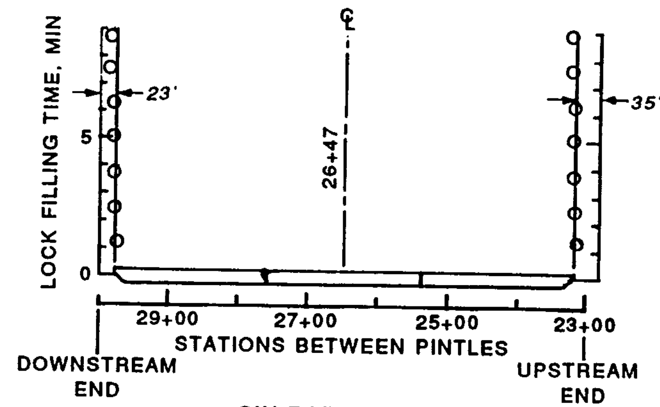
TYPE 4 DESIGN

1-MIN NORMAL VALVE OPERATION

U.P. EL 74.5, L.P. EL 5.0



FOUR-BARGE TOW



SIX-BARGE TOW

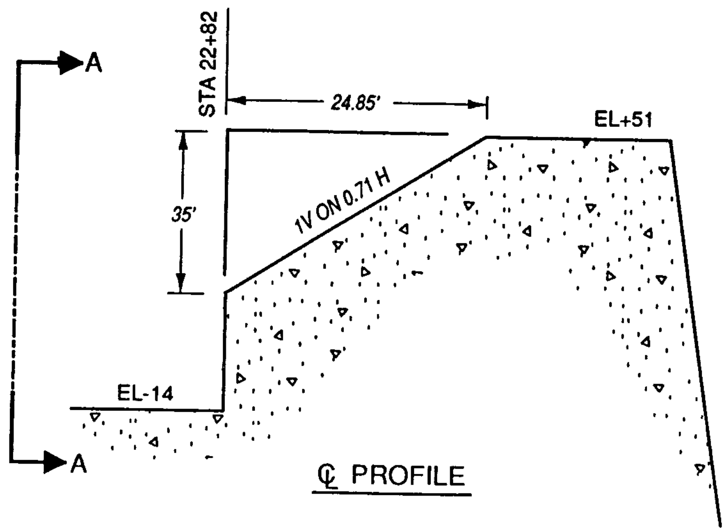
H-H PATTERN SYSTEM

TYPICAL FREE TOW MOVEMENT DURING FILLING OPERATIONS

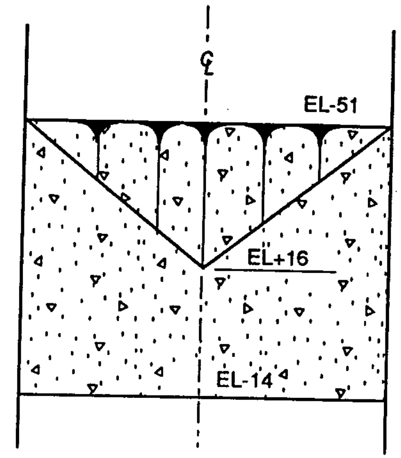
TYPE 4 DESIGN

1-MIN NORMAL VALVE OPERATION

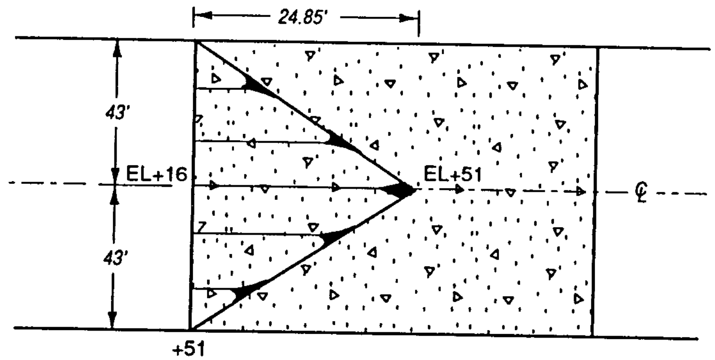
U.P. EL 72.5, L.P. EL 3.0



℄ PROFILE

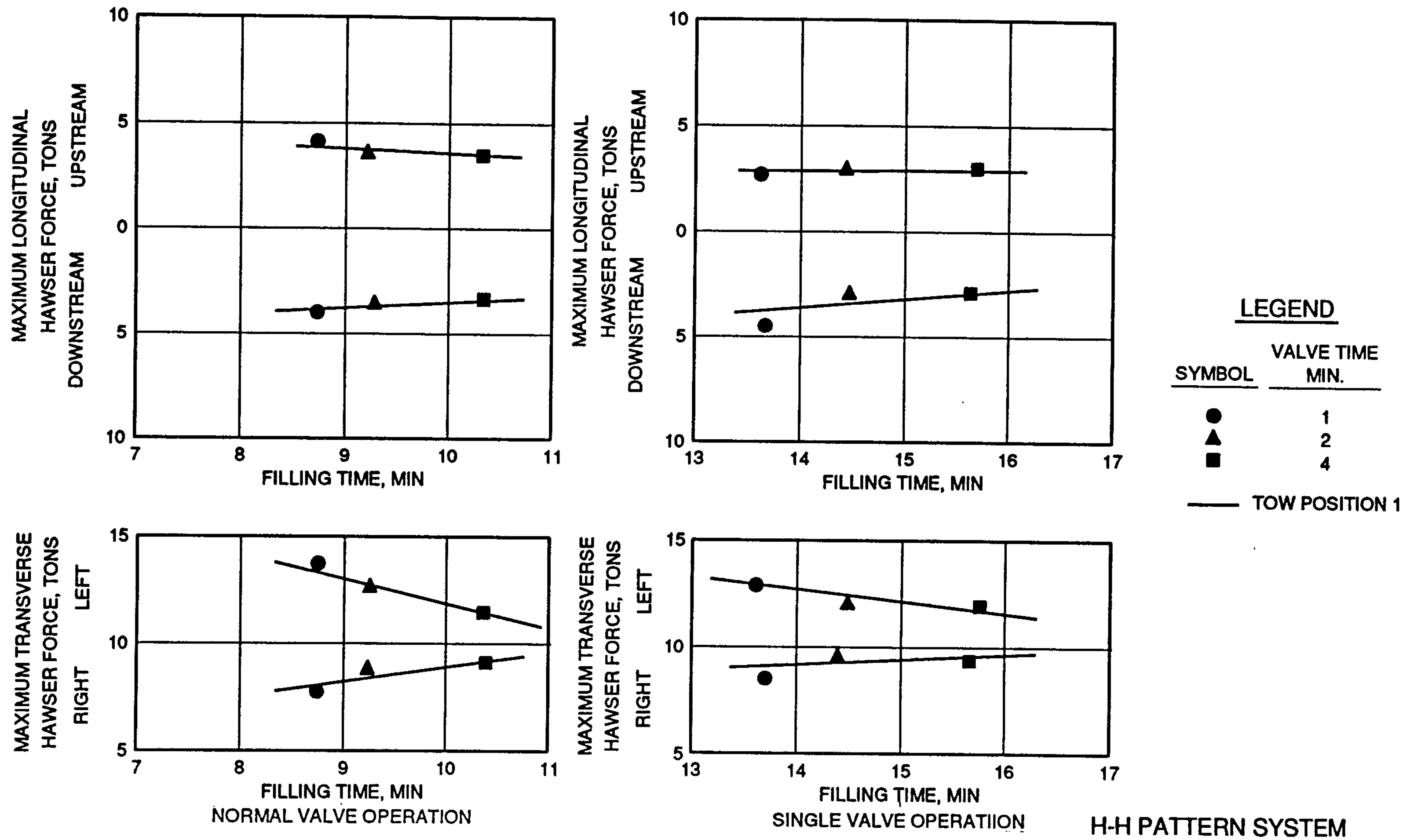


SECTION A-A

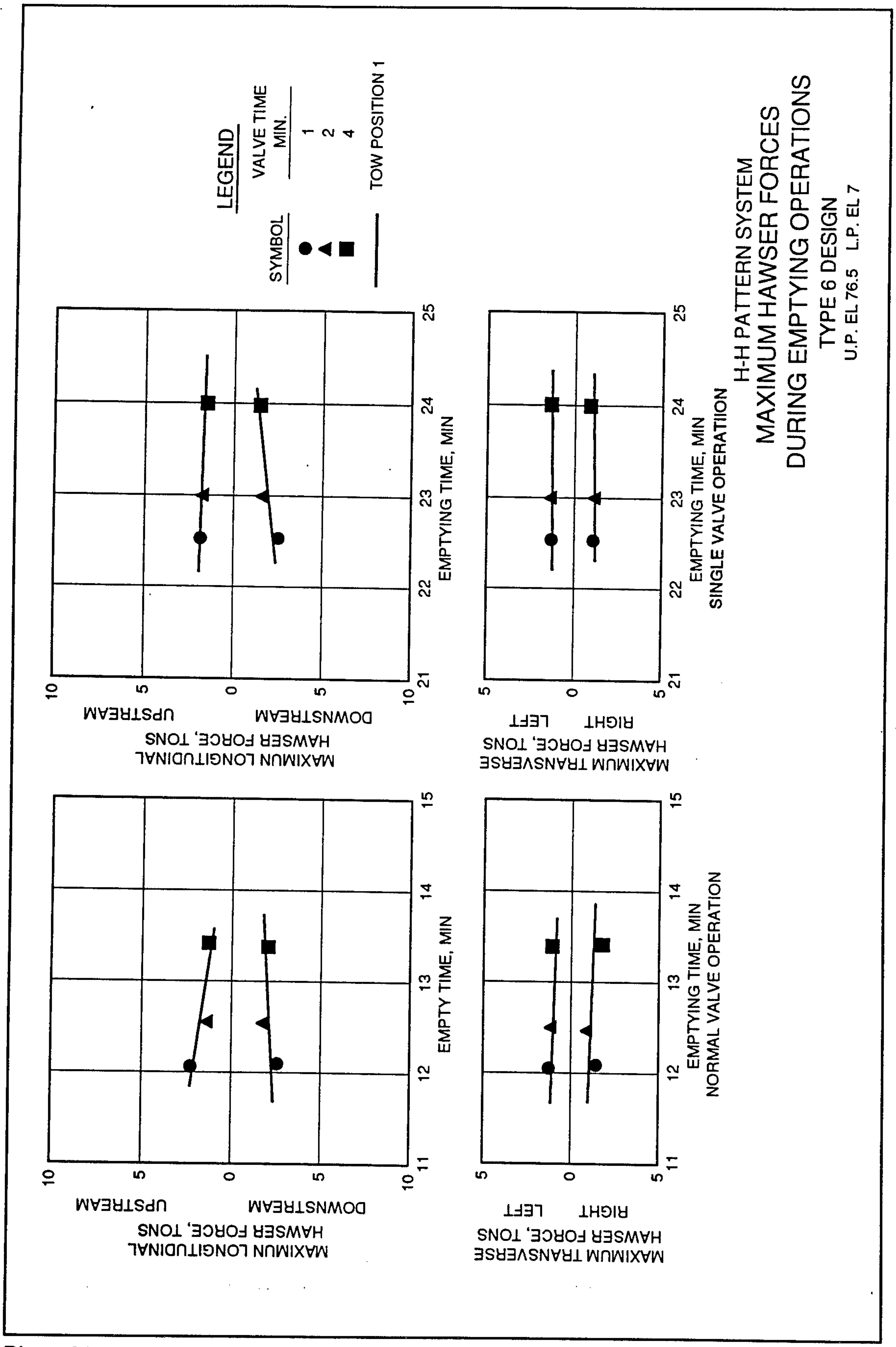


PLAN

H-H PATTERN SYSTEM
V-NOTCH MODIFICATION IN SILL
TYPE 6 DESIGN
FILLING AND EMPTYING SYSTEM

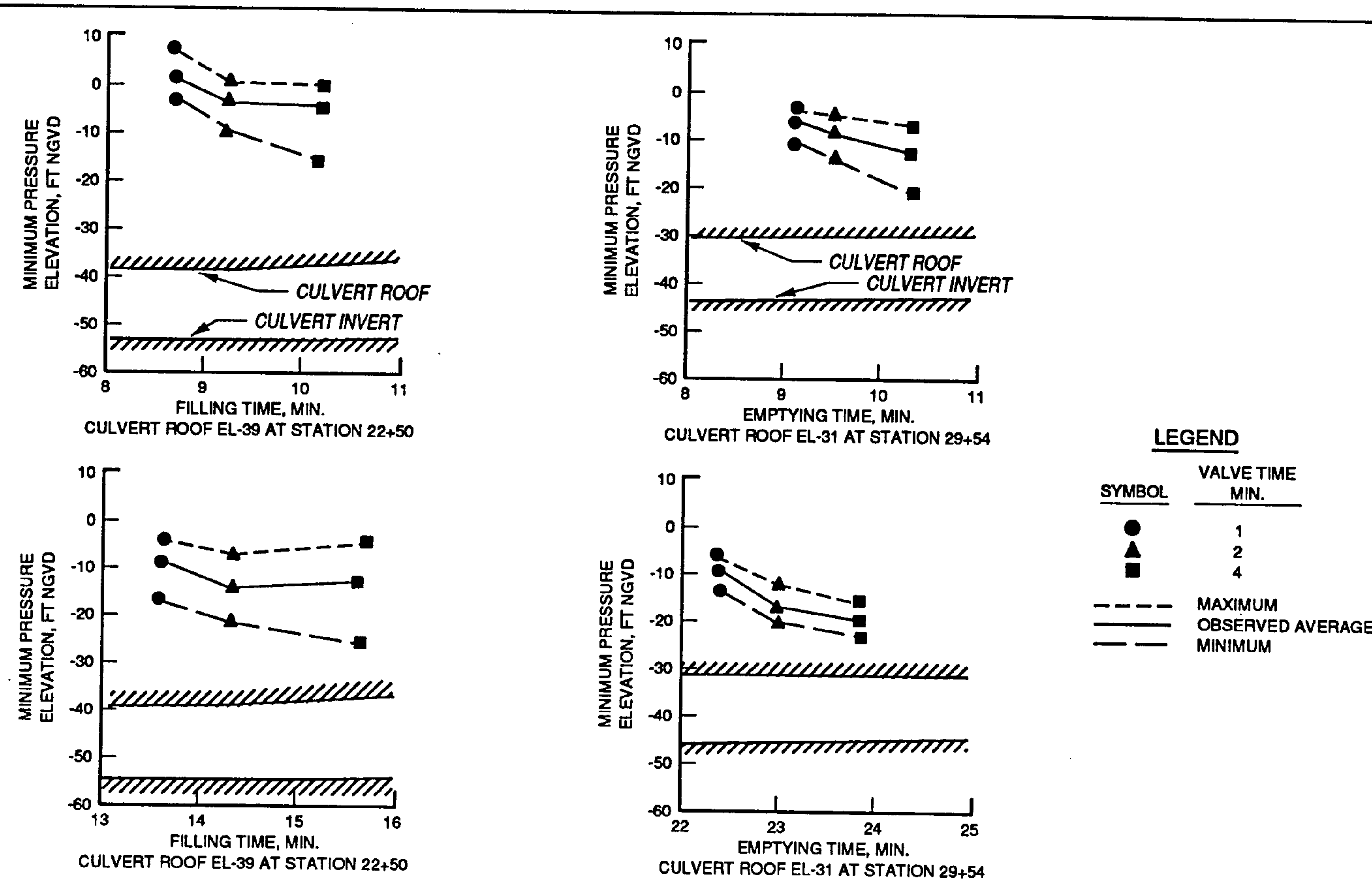


H-H PATTERN SYSTEM
MAXIMUM HAWSER FORCES
DURING FILLING OPERATIONS
TYPE 6 DESIGN
U.P. EL 76.5 L.P. EL 7



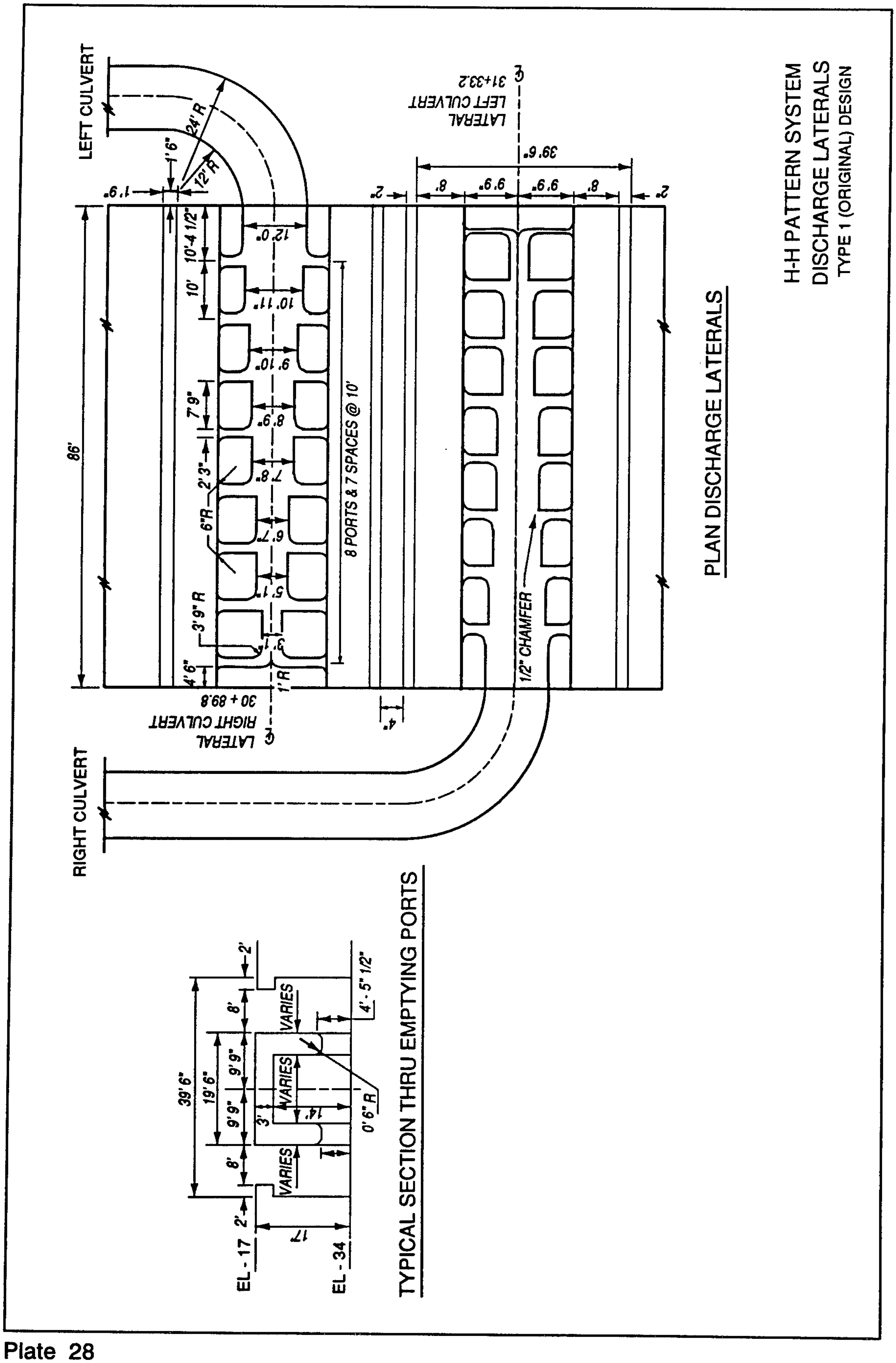
H-H PATTERN SYSTEM
MAXIMUM HAWSER FORCES
DURING EMPTYING OPERATIONS
TYPE 6 DESIGN
U.P. EL 76.5 L.P. EL 7
LEGEND
SYMBOL
VALVE TIME MIN.
1
2
4
TOW POSITION 1
MAXIMUN LONGITUDINAL HAWSER FORCE, TONS
UPSTREAM
DOWNSTREAM
MAXIMUM TRANSVERSE HAWSER FORCE, TONS
LEFT
RIGHT
EMPTYING TIME, MIN
EMPTY TIME, MIN
SINGLE VALVE OPERATIION
NORMAL VALVE OPERATION

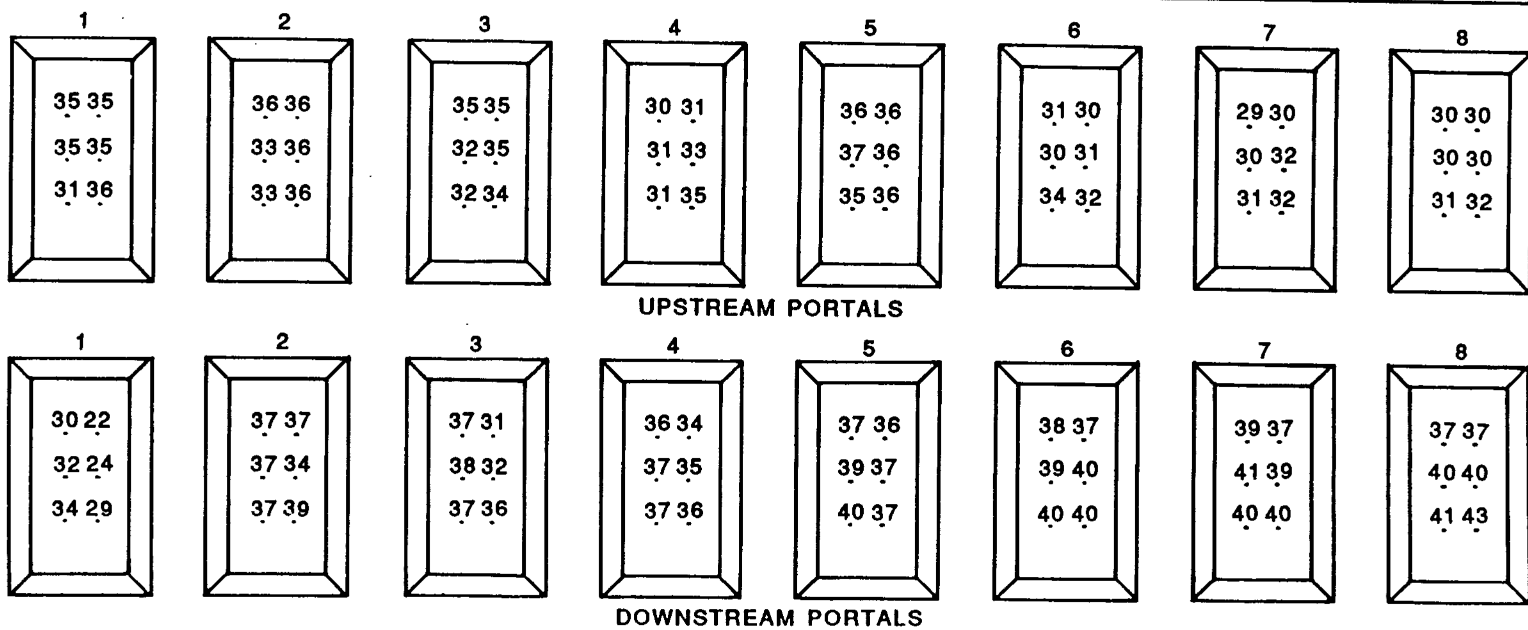
Plate 26

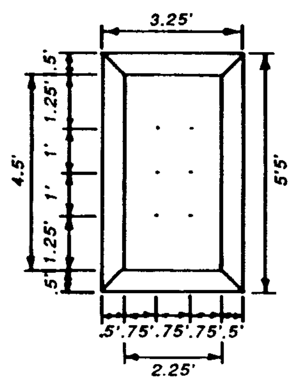


H-H PATTERN SYSTEM

CULVERT ROOF PRESSURES
DOWNSTREAM OF FILLING AND EMPTYING VALVES
TYPE 2 DESIGN
FILLING AND EMPTYING SYSTEM


H-H PATTERN SYSTEM
DISCHARGE LATERALS
TYPE 1 (ORIGINAL) DESIGN
PLAN DISCHARGE LATERALS
TYPICAL SECTION THRU EMPTYING PORTS
LEFT CULVERT
RIGHT CULVERT
LATERAL LEFT CULVERT 31+33.2
LATERAL RIGHT CULVERT 30 + 89.8
8 PORTS & 7 SPACES @ 10'
1/2" CHAMFER
86'
39'6"
19'6"
VARIES
EL - 17
EL - 34

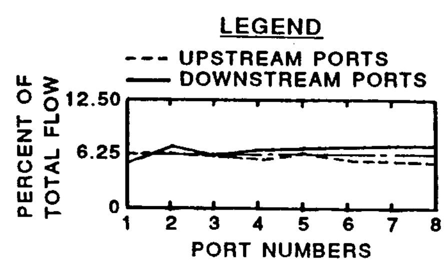




LOCATION OF
PORT VELOCITY
MEASUREMENTS

STEADY-FLOW TEST CONDITIONS
UPPER MITER GATES OPEN
FILL VALVES CLOSED
LOWER MITER GATES CLOSED
EMPTYING VALVES OPEN FULL
UPPER POOL 76.5
LOWER POOL +7

NOTE: VELOCITIES ARE
IN FEET PER SECOND.



H-H PATTERN SYSTEM
VELOCITIES AND
FLOW DISTRIBUTION
AT OUTLET PORTS
UPSTREAM DISCHARGE LATERALS

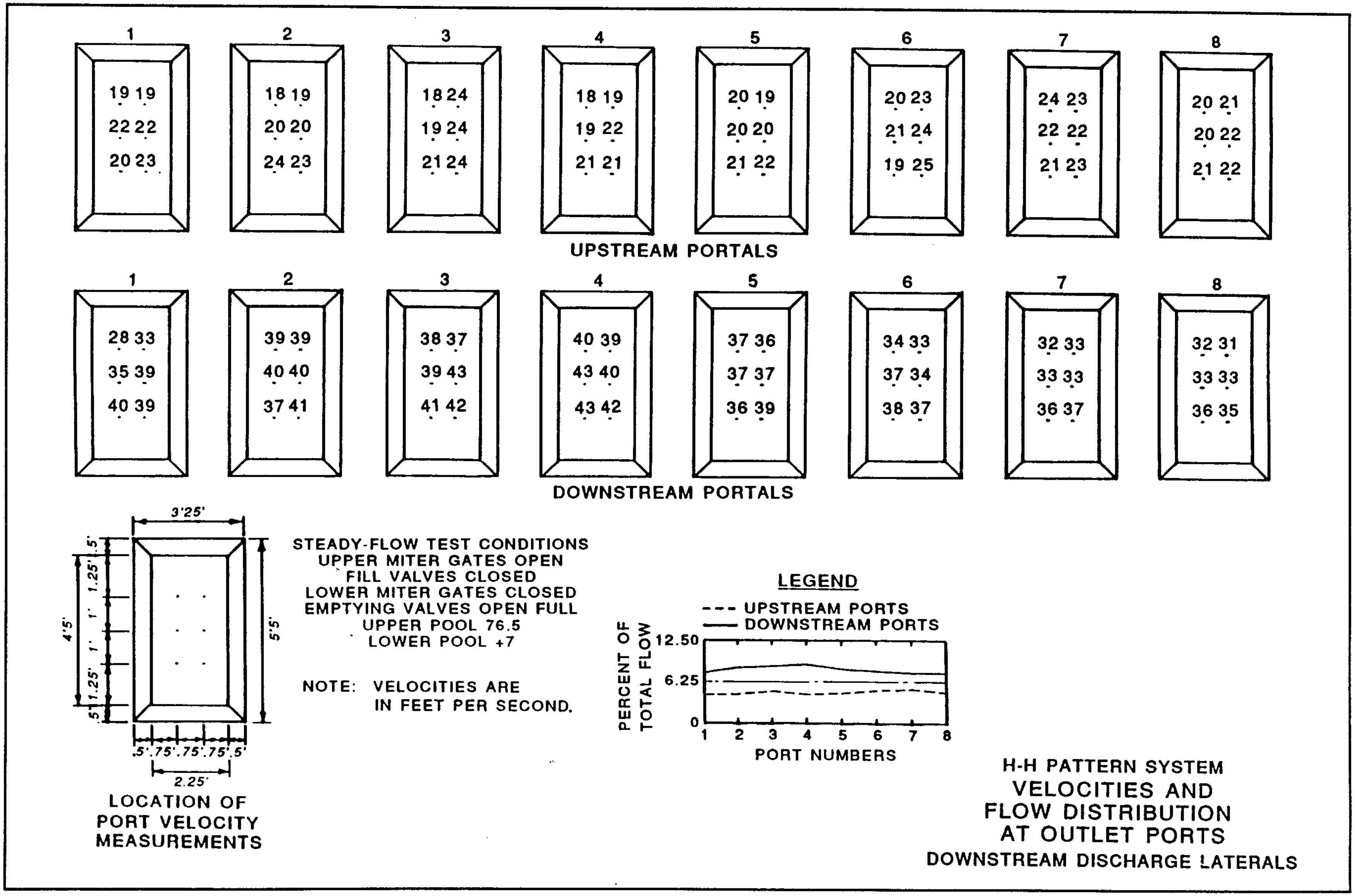
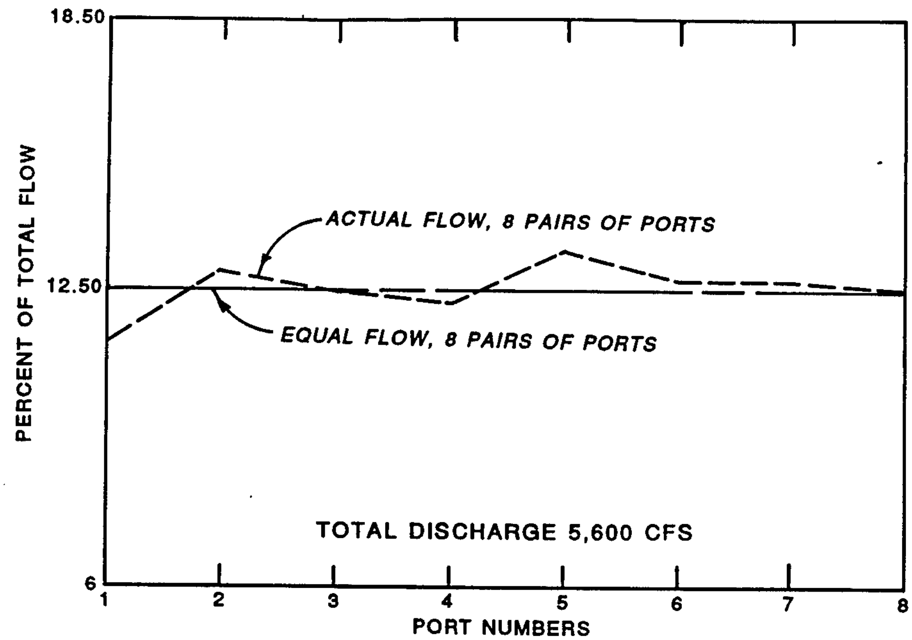
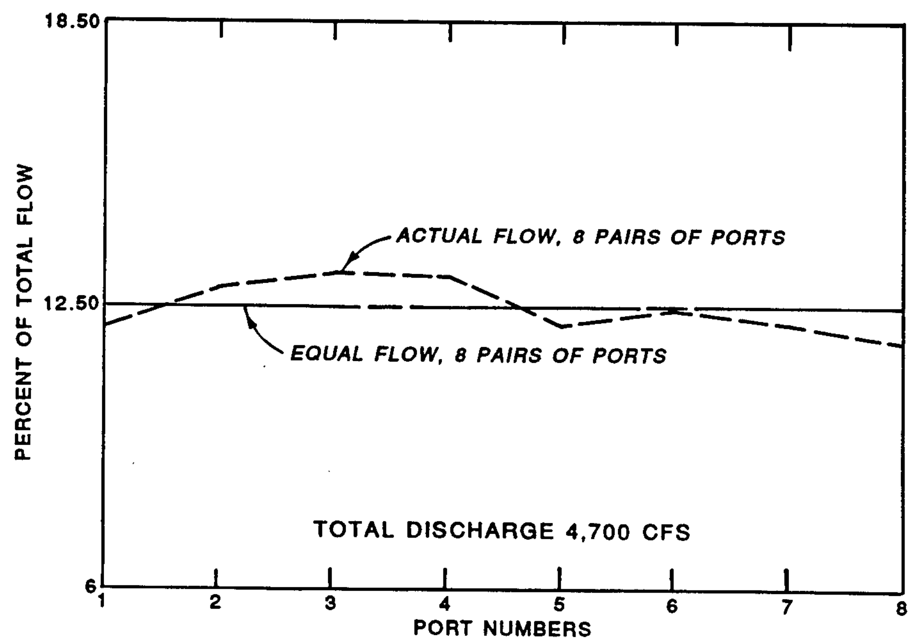

1 2 3 4 5 6 7 8
19 19 / 22 22 / 20 23
18 19 / 20 20 / 24 23
18 24 / 19 24 / 21 24
18 19 / 19 22 / 21 21
20 19 / 20 20 / 21 22
20 23 / 21 24 / 19 25
24 23 / 22 22 / 21 23
20 21 / 20 22 / 21 22
UPSTREAM PORTALS
28 33 / 35 39 / 40 39
39 39 / 40 40 / 37 41
38 37 / 39 43 / 41 42
40 39 / 43 40 / 43 42
37 36 / 37 37 / 36 39
34 33 / 37 34 / 38 37
32 33 / 33 33 / 36 37
32 31 / 33 33 / 36 35
DOWNSTREAM PORTALS
3'25'
4'5'
5'5'
.5' 1.25' 1' 1' 1.25' .5'
.5' .75' .75' .75' .5'
2.25'
LOCATION OF
PORT VELOCITY
MEASUREMENTS
STEADY-FLOW TEST CONDITIONS
UPPER MITER GATES OPEN
FILL VALVES CLOSED
LOWER MITER GATES CLOSED
EMPTYING VALVES OPEN FULL
UPPER POOL 76.5
LOWER POOL +7
NOTE: VELOCITIES ARE
IN FEET PER SECOND.
LEGEND
--- UPSTREAM PORTS
—— DOWNSTREAM PORTS
PERCENT OF TOTAL FLOW
12.50
6.25
0
1 2 3 4 5 6 7 8
PORT NUMBERS
H-H PATTERN SYSTEM
VELOCITIES AND
FLOW DISTRIBUTION
AT OUTLET PORTS
DOWNSTREAM DISCHARGE LATERALS

Plate 30



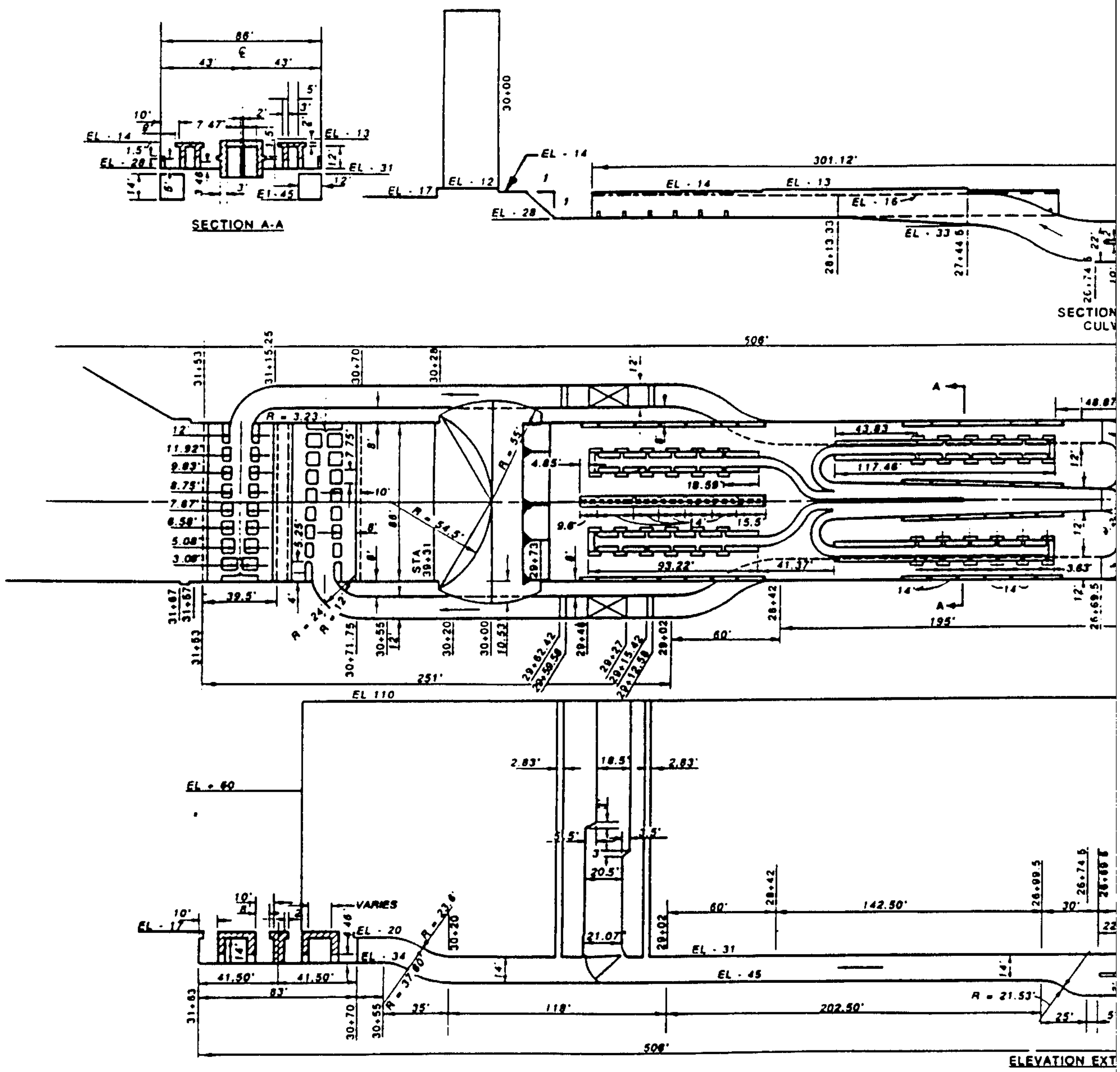
UPSTREAM DISCHARGE LATERAL

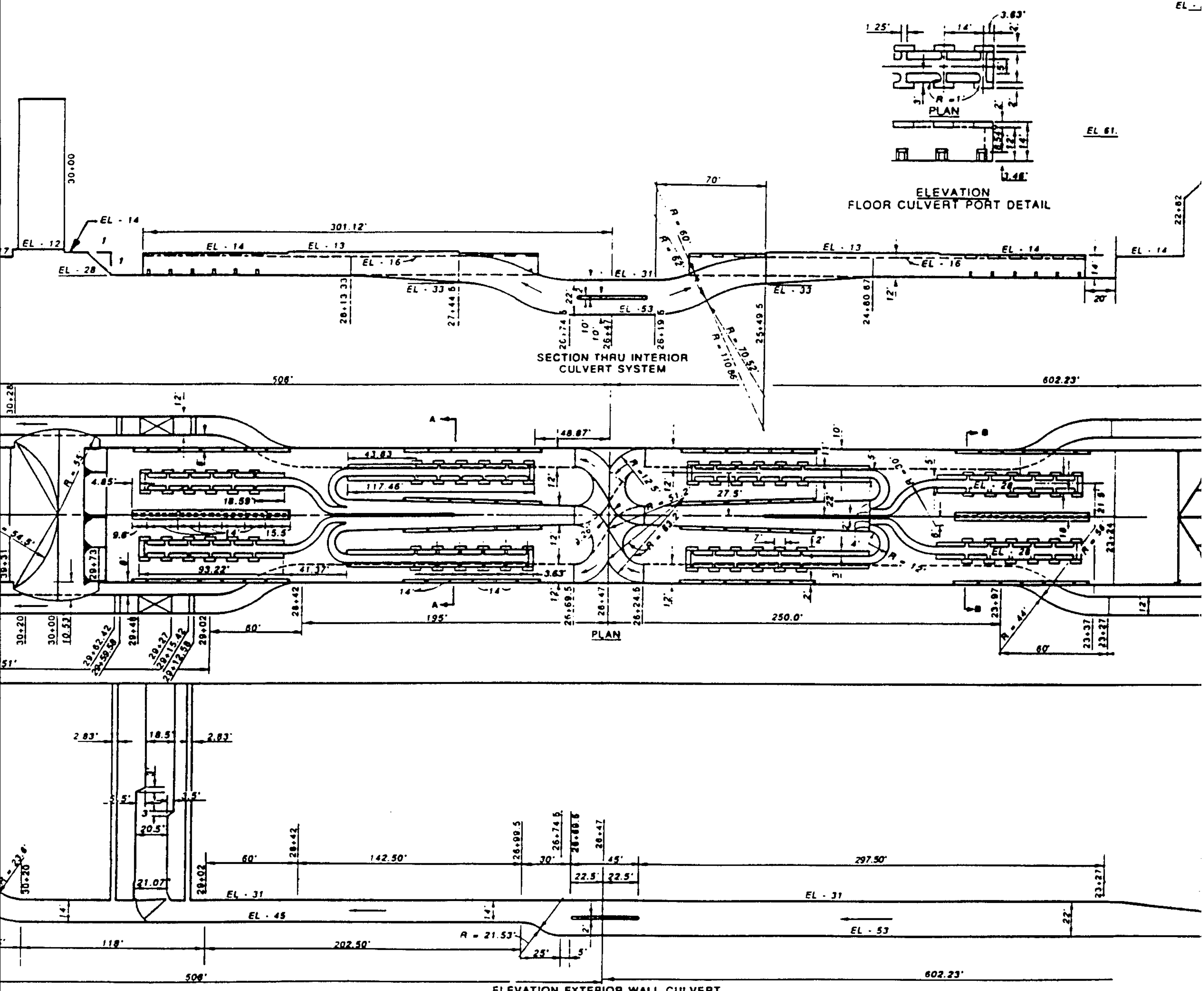


DOWNSTREAM DISCHARGE LATERAL

H-H PATTERN SYSTEM

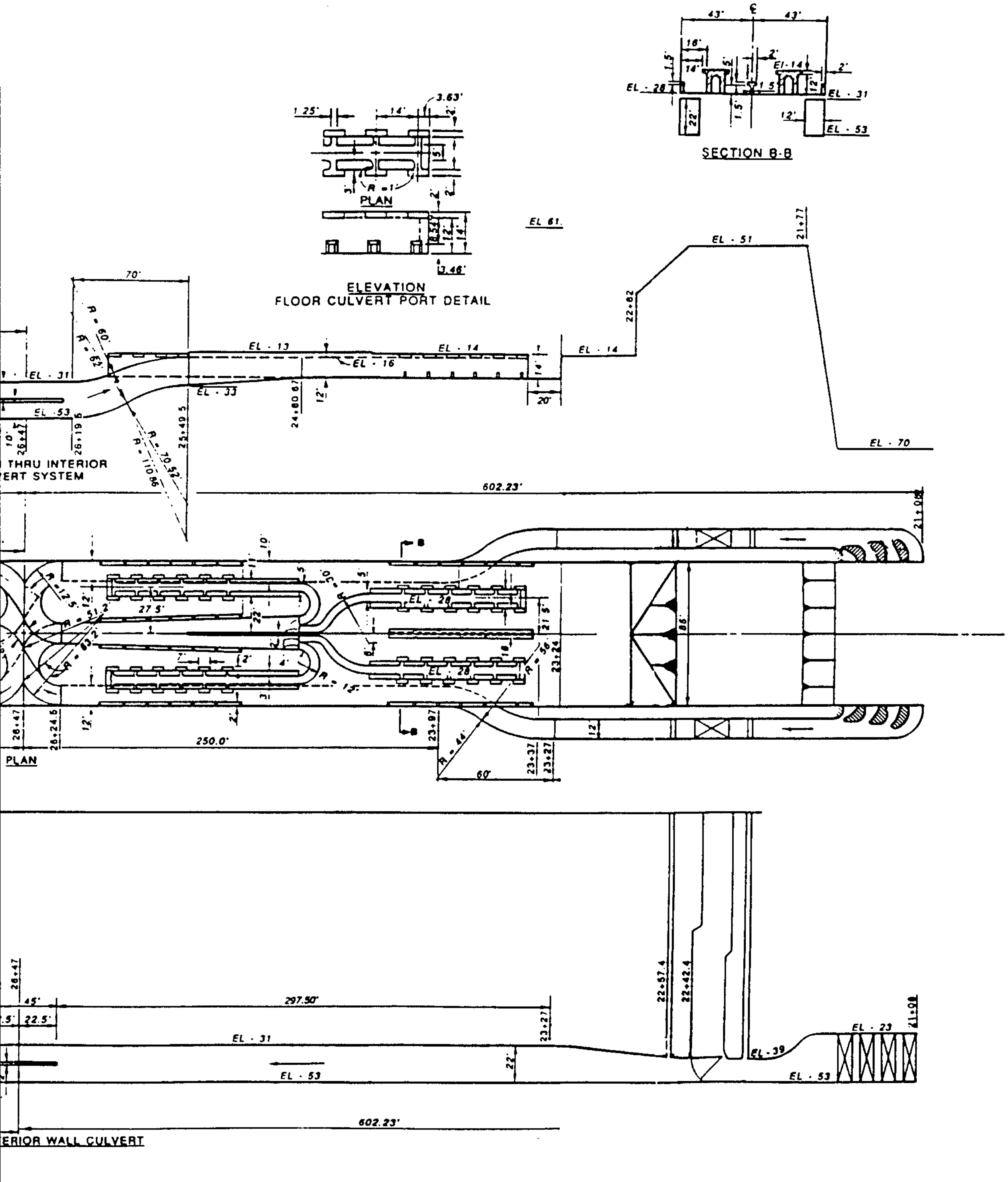
PAIRS OF PORTS
FLOW DISTRIBUTION


SECTION A-A
EL - 14
EL - 13
EL - 28
EL - 31
EL - 17
EL - 12
EL - 45
301.12'
506'
251'
EL 110
EL + 60
2.83'
18.5'
VARIES
EL - 20
EL - 34
60'
142.50'
202.50'
118'
35'
41.50'
83'
195'

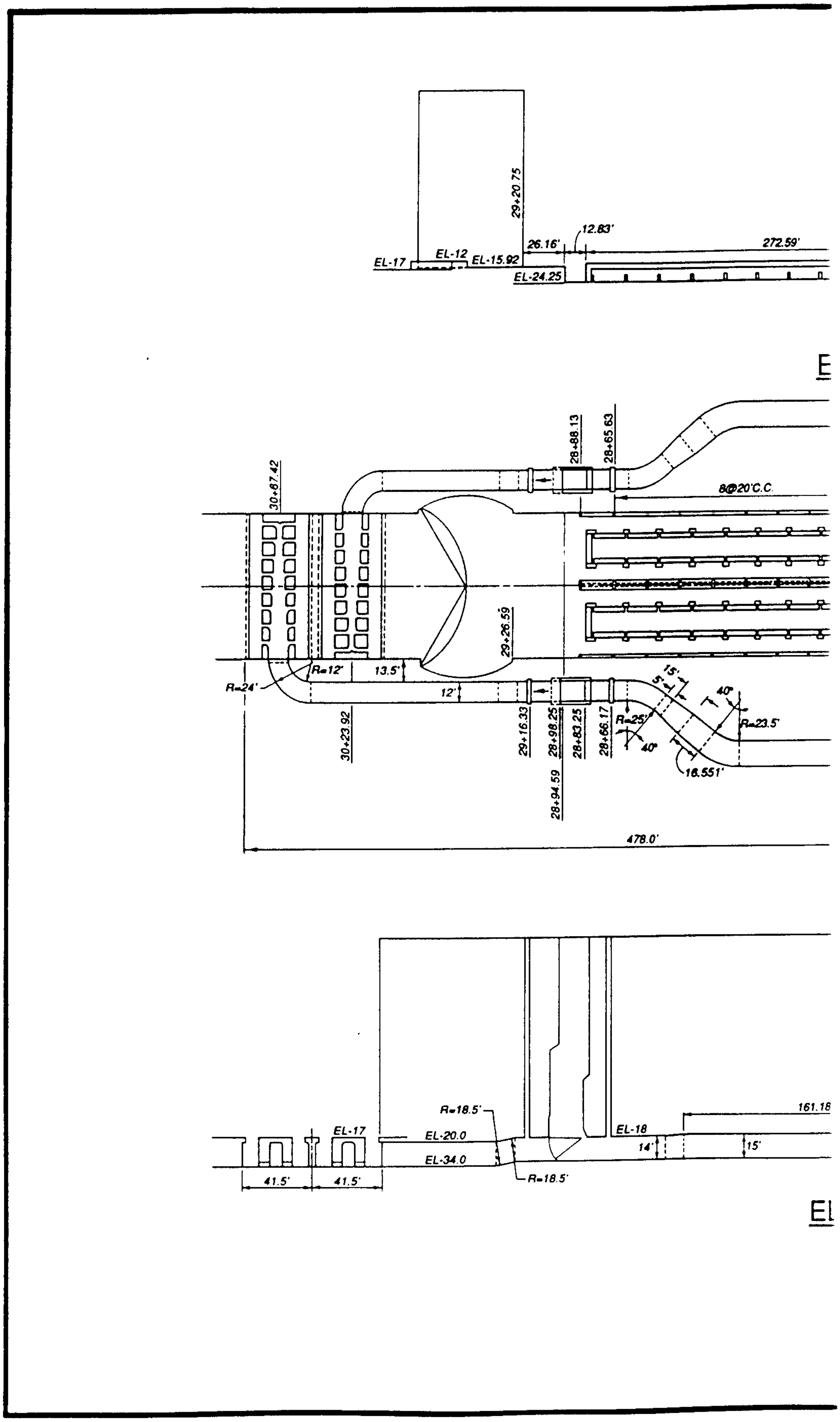

PLAN
ELEVATION
FLOOR CULVERT PORT DETAIL
SECTION THRU INTERIOR CULVERT SYSTEM
PLAN
ELEVATION EXTERIOR WALL CULVERT

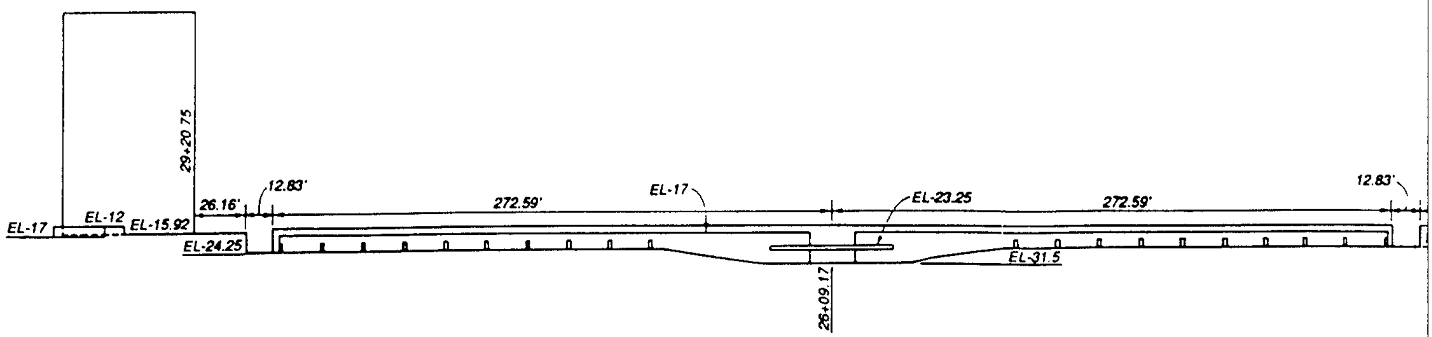
H-

FILLING

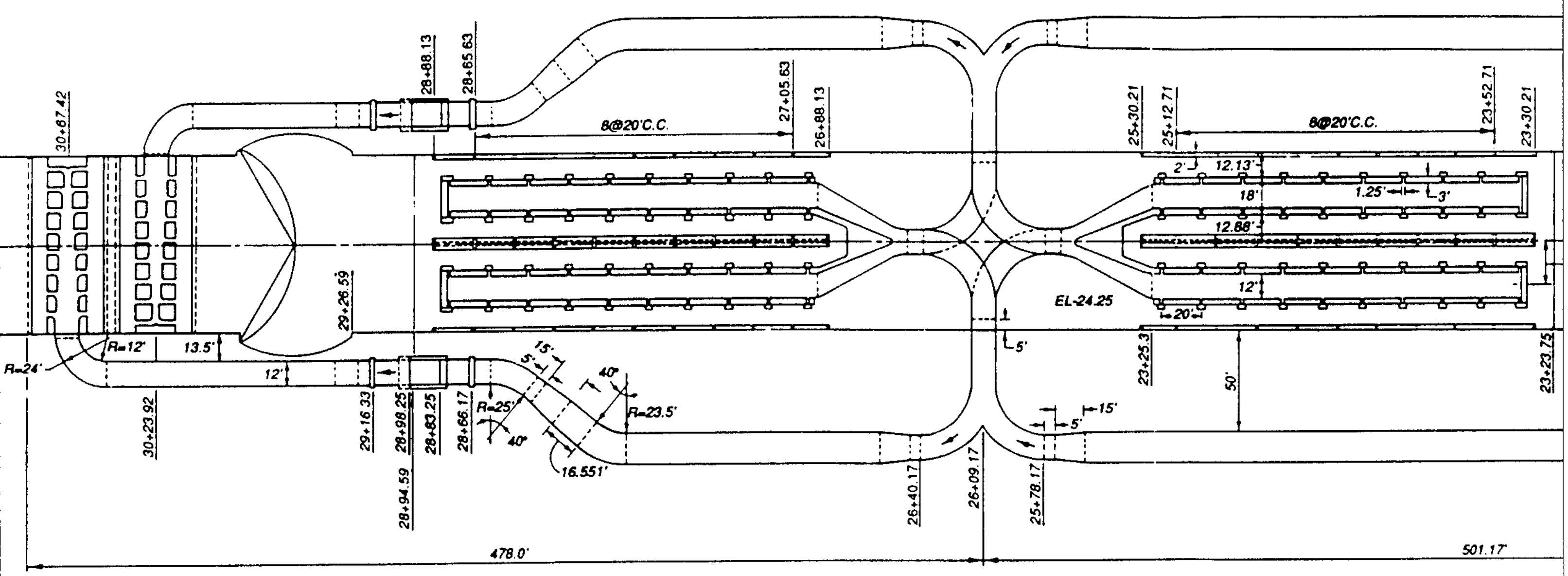


H-H PATTERN SYSTEM
TYPE 6 DESIGN
FILLING AND EMPTYING SYSTEM

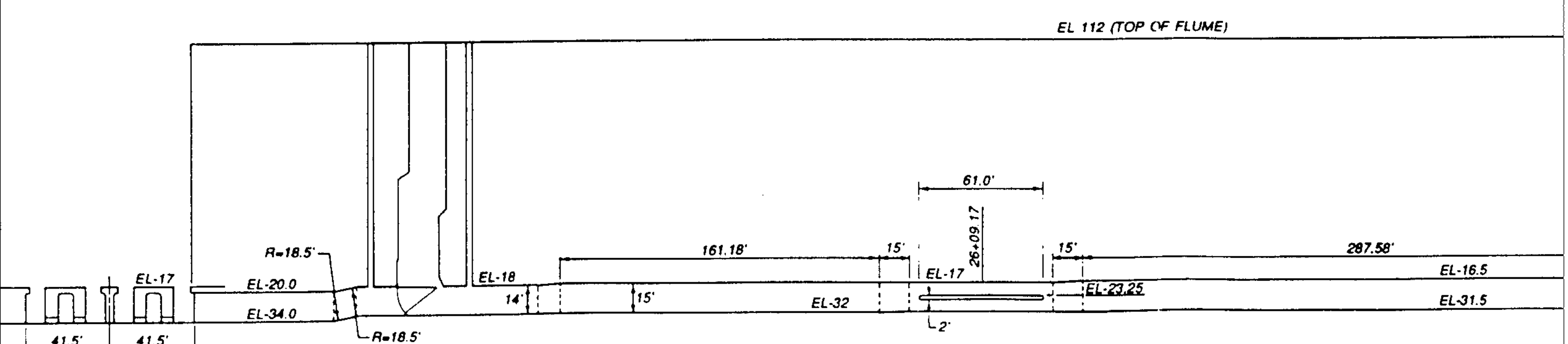

29+20.75
12.83'
26.16'
272.59'
EL-17
EL-12
EL-15.92
EL-24.25
28+88.13
28+65.63
30+67.42
8@20'C.C.
29+26.59
R=12'
13.5'
R=24'
12'
30+23.92
29+16.33
28+98.25
28+83.25
28+66.17
28+94.59
15'
5'
40°
R=25'
R=23.5'
16.551'
478.0'
R=18.5'
EL-17
EL-20.0
EL-34.0
EL-18
161.18
14'
15'
41.5'
41.5'
R=18.5'



ELEVATION INTERIOR CULVERT

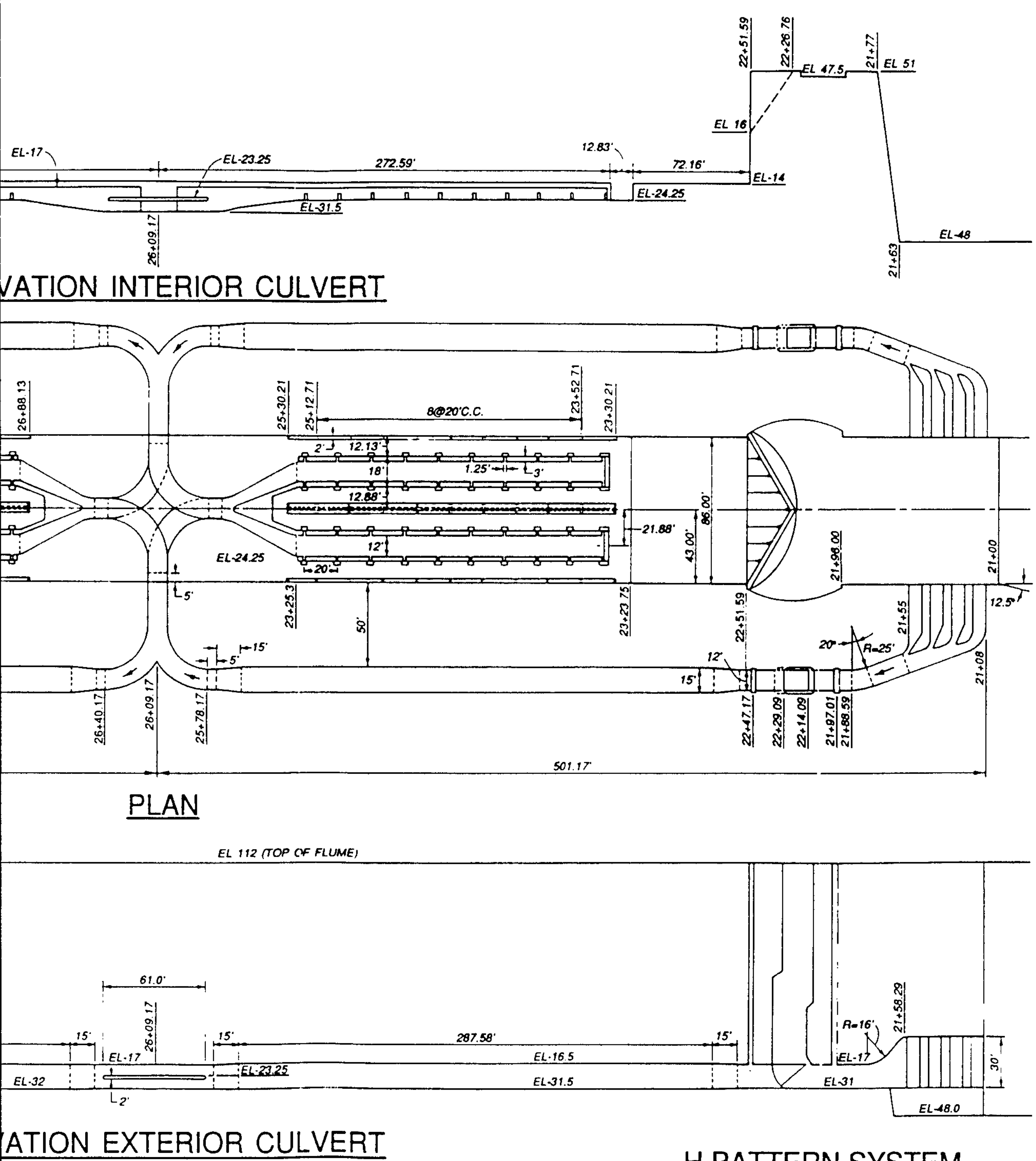


PLAN



ELEVATION EXTERIOR CULVERT

FILLIN
TY

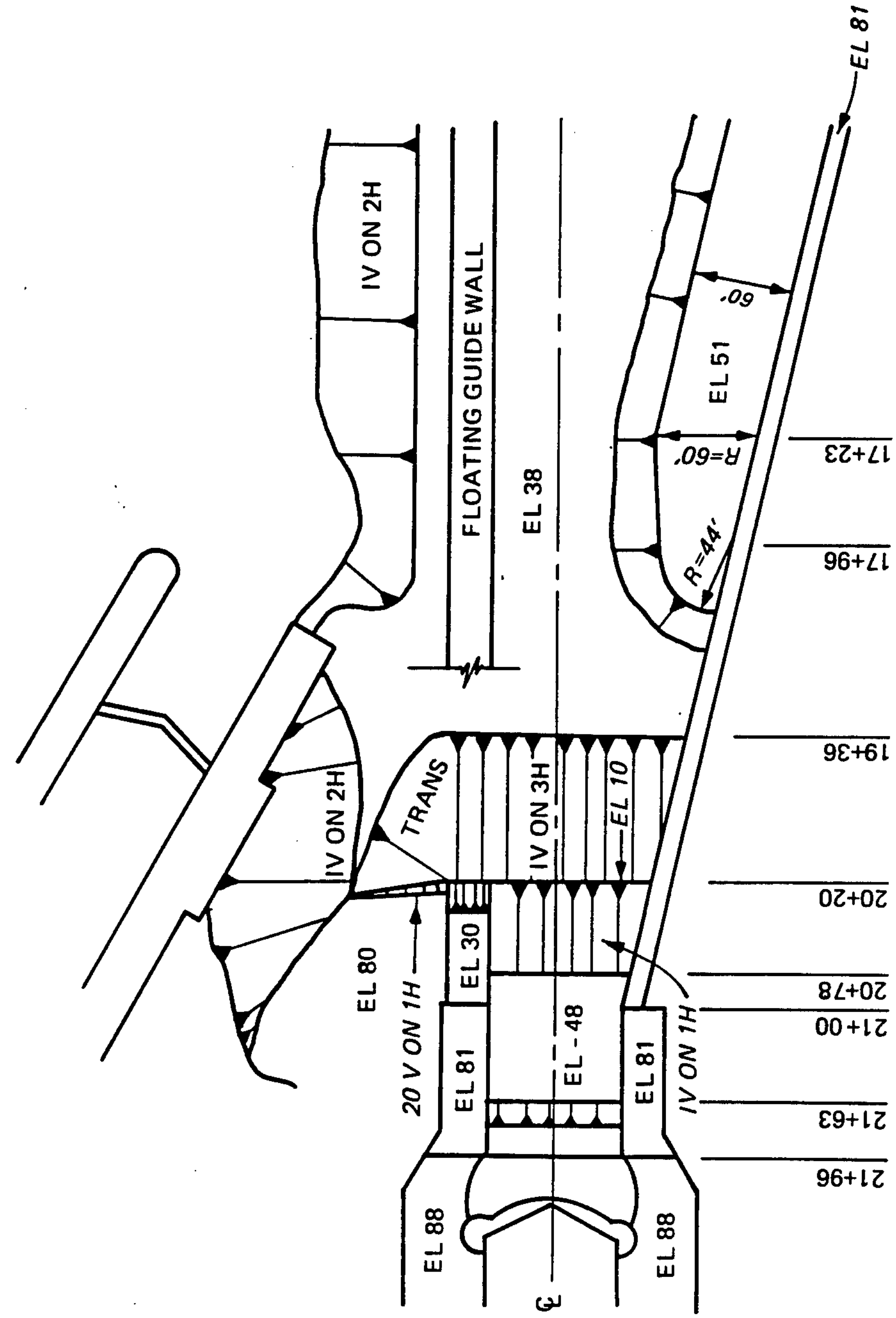


H PATTERN SYSTEM

FILLING & EMPTYING SYSTEM

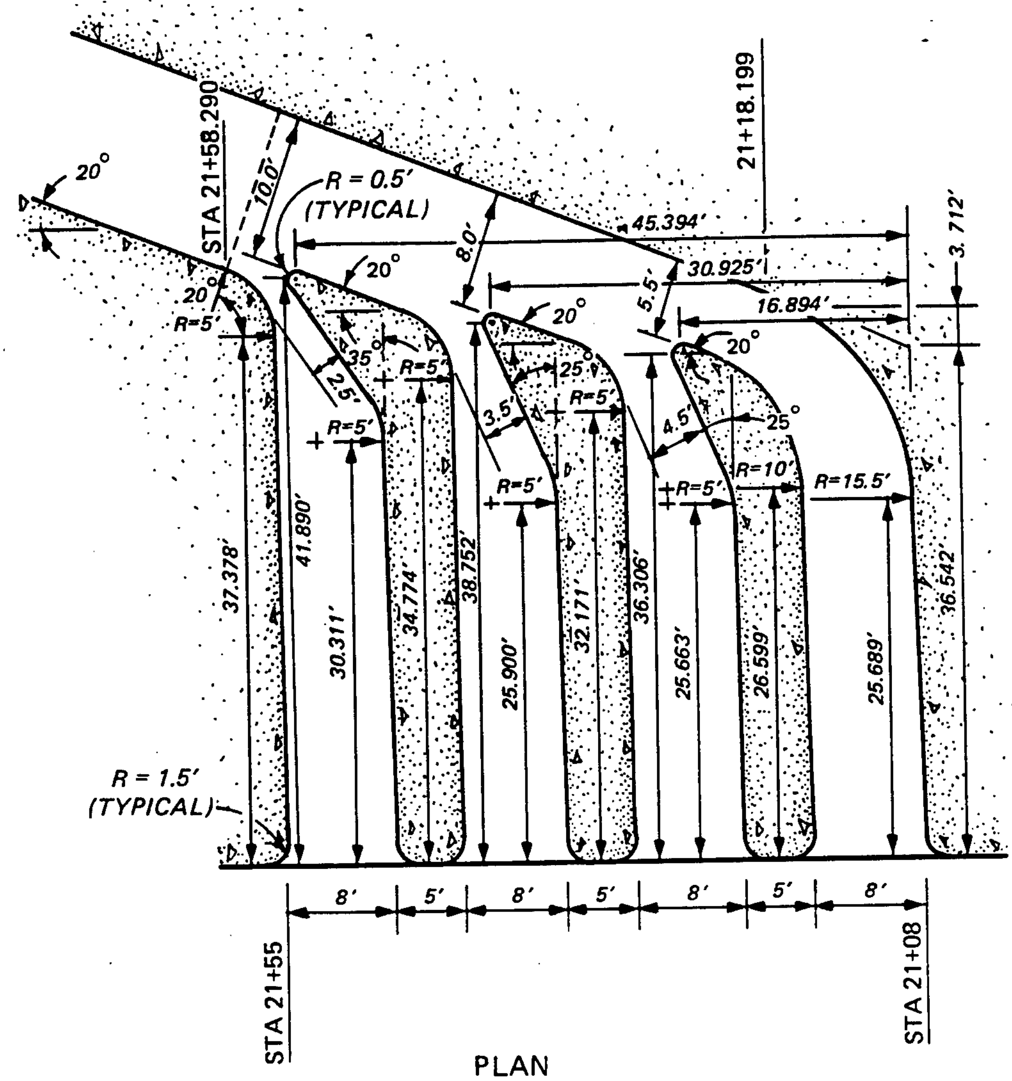
TYPE 1 (ORIGINAL) DESIGN

Plate 33



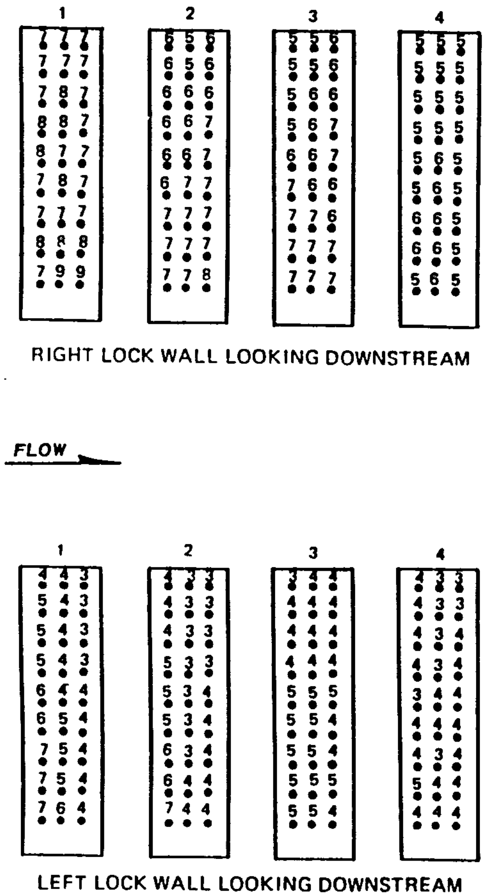
H PATTERN SYSTEM
UPSTREAM APPROACH
TYPE 1 (ORIGINAL) DESIGN

Plate 34



H PATTERN SYSTEM

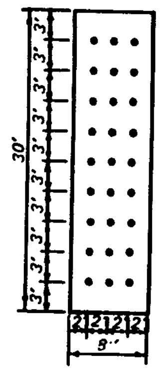
INTAKE MANIFOLD
TYPE 1 (ORIGINAL) DESIGN



RIGHT LOCK WALL LOOKING DOWNSTREAM

LEFT LOCK WALL LOOKING DOWNSTREAM

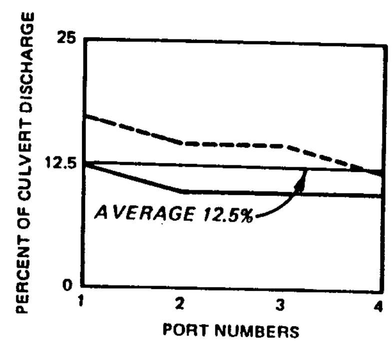
VELOCITIES AT PORT FACE



LOCATION OF PORT VELOCITY MEASUREMENT

TEST CONDITIONS
TOTAL DISCHARGE 9,800 CFS
UPPER POOL EL 76.5
LOCK CHAMBER EL 7.0
FILLING VALVES OPEN FULL
UPPER MITER GATES CLOSED
EMPTYING VALVES CLOSED
LOWER MITER GATES OPEN

NOTE: VELOCITIES ARE IN PROTOTYPE FEET PER SECOND AND ARE MEASURED AT WALL FACE OF INTAKE MANIFOLDS



FLOW DISTRIBUTION

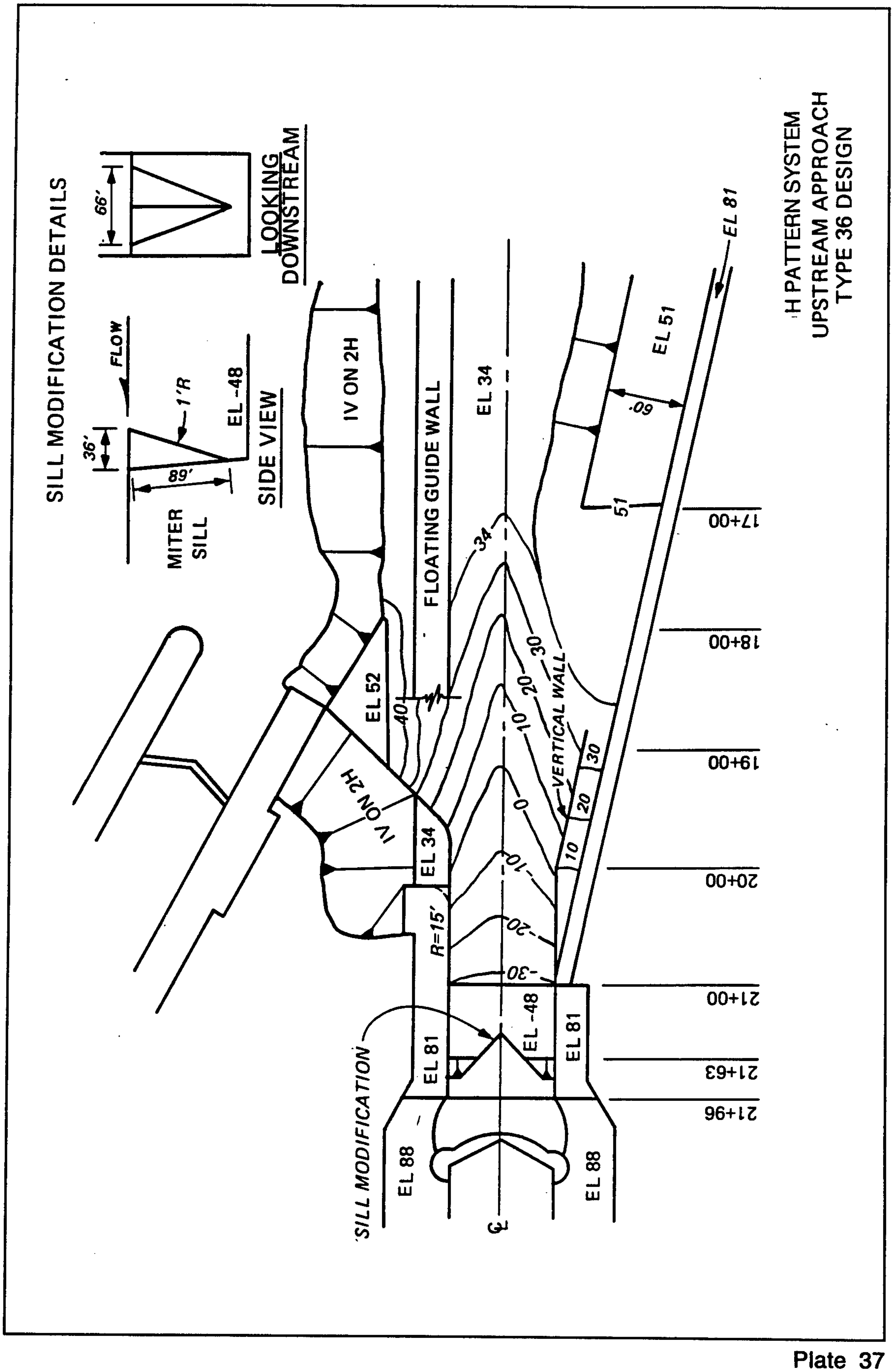
LEGEND

——— LEFT LOCK WALL LOOKING DOWNSTREAM (41.5% OF TOTAL FLOW)

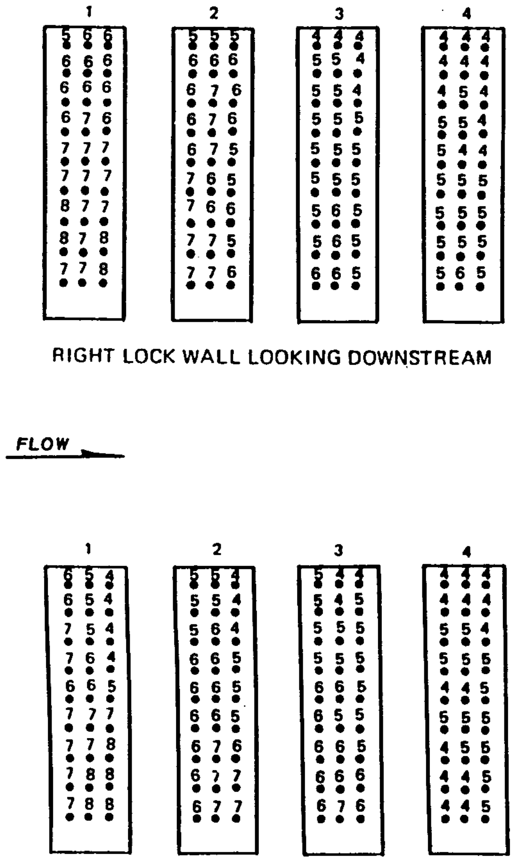
- - - - - RIGHT LOCK WALL LOOKING DOWNSTREAM (58.5% OF TOTAL FLOW)

H PATTERN SYSTEM

INTAKE MANIFOLD VELOCITIES AND FLOW DISTRIBUTION
TYPE 1 (ORIGINAL) DESIGN APPROACH
STEADY FLOW CONDITIONS



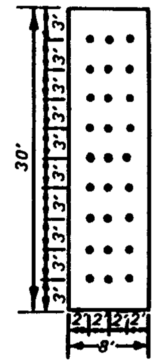
H PATTERN SYSTEM
UPSTREAM APPROACH
TYPE 36 DESIGN



RIGHT LOCK WALL LOOKING DOWNSTREAM

LEFT LOCK WALL LOOKING DOWNSTREAM

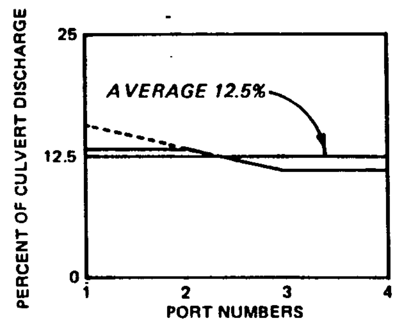
VELOCITIES AT PORT FACE



LOCATION OF PORT VELOCITY MEASUREMENT

TEST CONDITIONS
TOTAL DISCHARGE 10,800 CFS
UPPER POOL 76.5
LOCK CHAMBER EL 7.0
FILLING VALVES OPEN FULL
UPPER MITER GATES CLOSED
EMPTYING VALVES CLOSED
LOWER MITER GATES OPEN

NOTE: VELOCITIES ARE IN PROTOTYPE FEET PER SECOND AND ARE MEASURED AT WALL FACE OF INTAKE MANIFOLDS



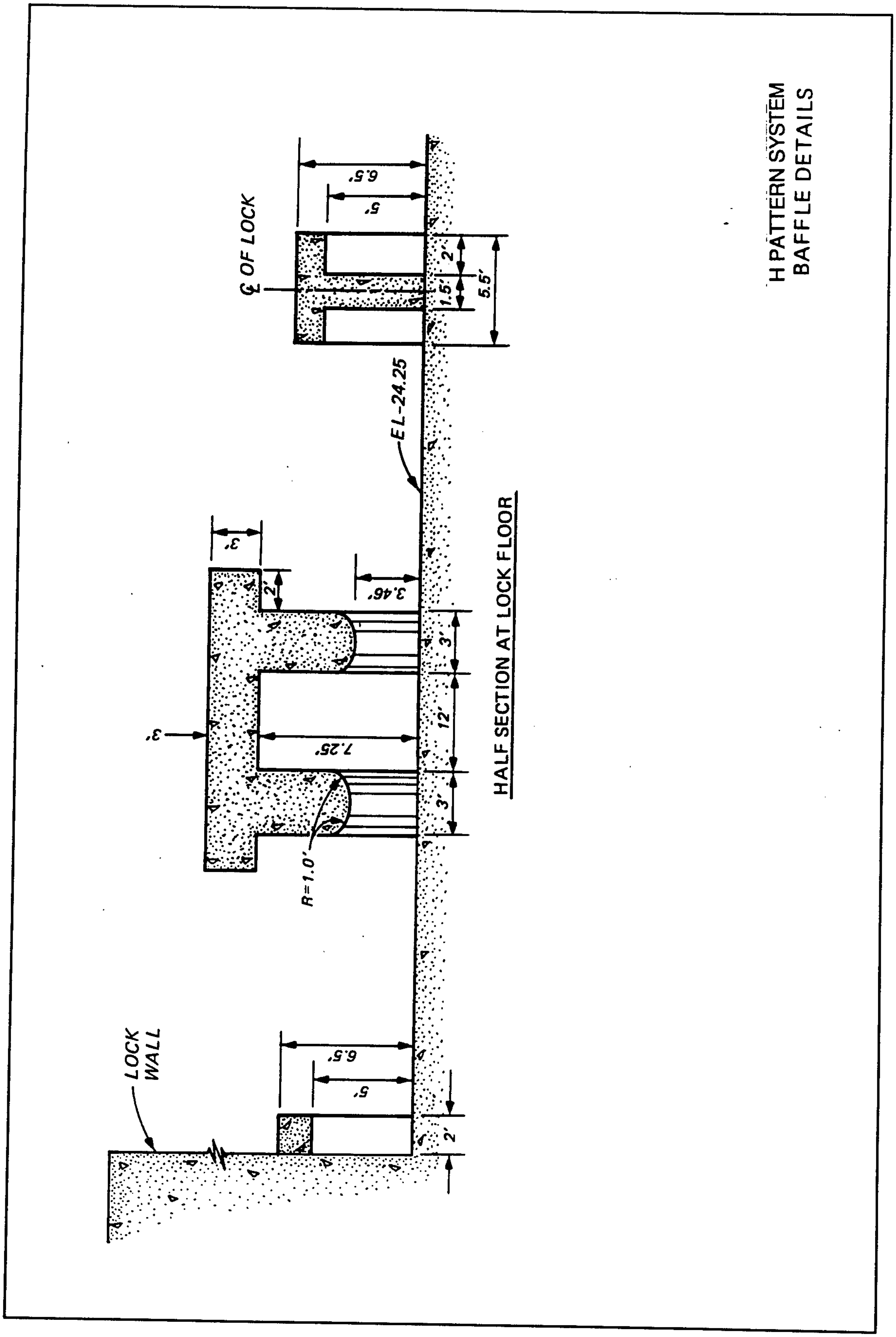
FLOW DISTRIBUTION

LEGEND

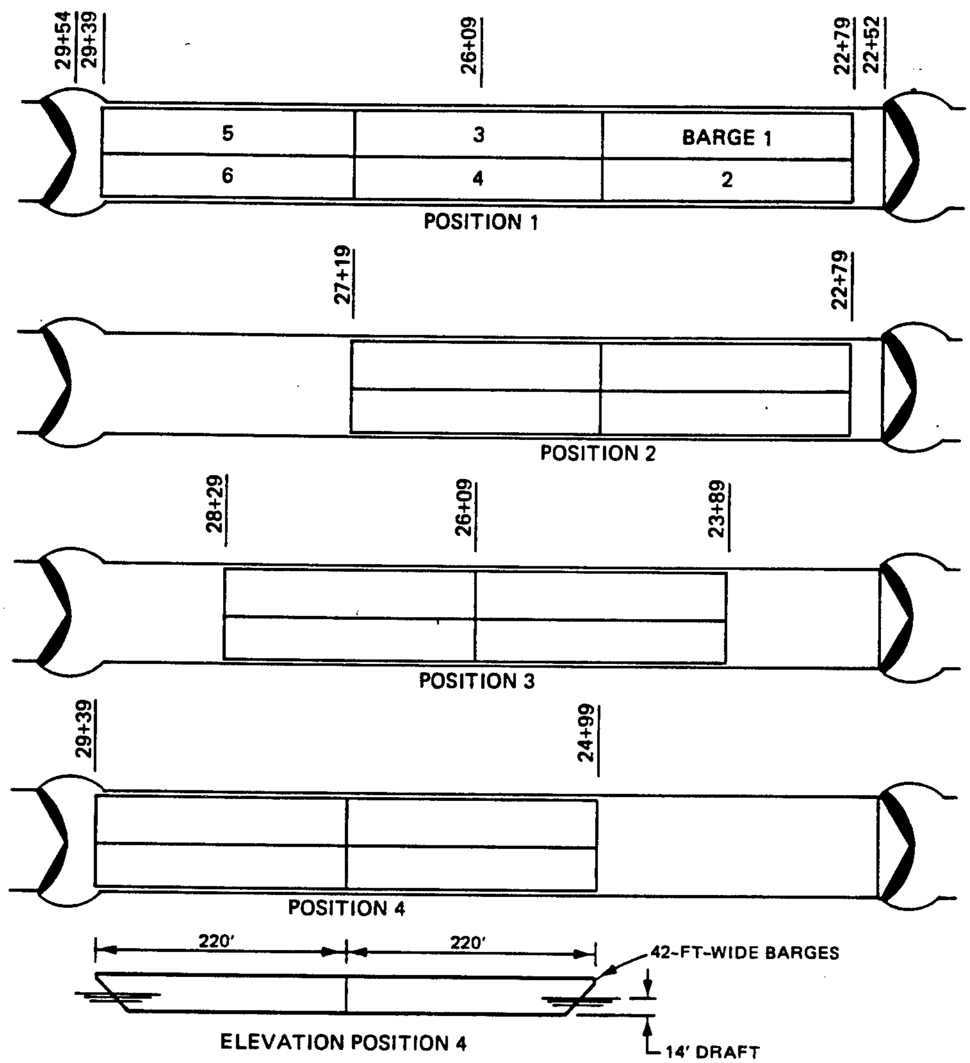
—— LEFT LOCK WALL LOOKING DOWNSTREAM (48.8% IF TOTAL FLOW)

------ RIGHT LOCK WALL LOOKING DOWNSTREAM (51.2% OF TOTAL FLOW)

H PATTERN SYSTEM
INTAKE VELOCITIES AND FLOW DISTRIBUTION
TYPE 36 DESIGN APPROACH
STEADY FLOW CONDITIONS



H PATTERN SYSTEM
BAFFLE DETAILS

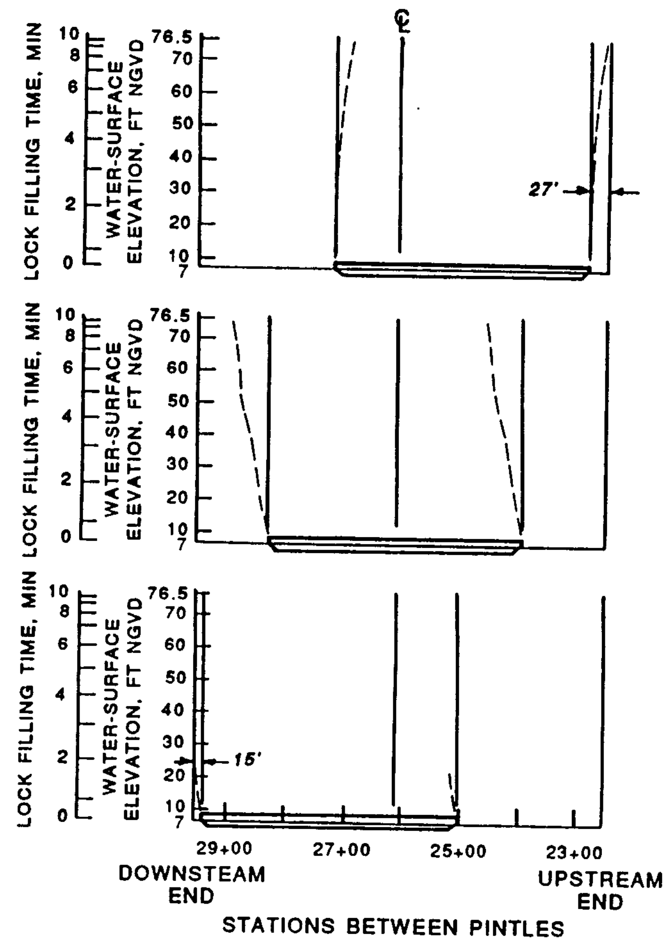


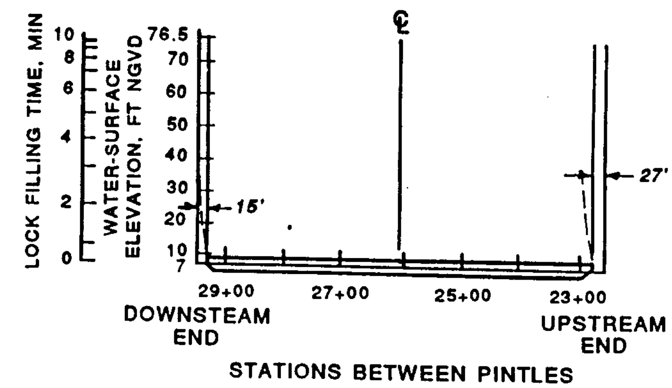
NOTE: STATION 26+09 IS CENTER LINE OF CENTRAL DISTRIBUTION SYSTEM

H PATTERN SYSTEM

BARGE POSITIONS AND DETAILS

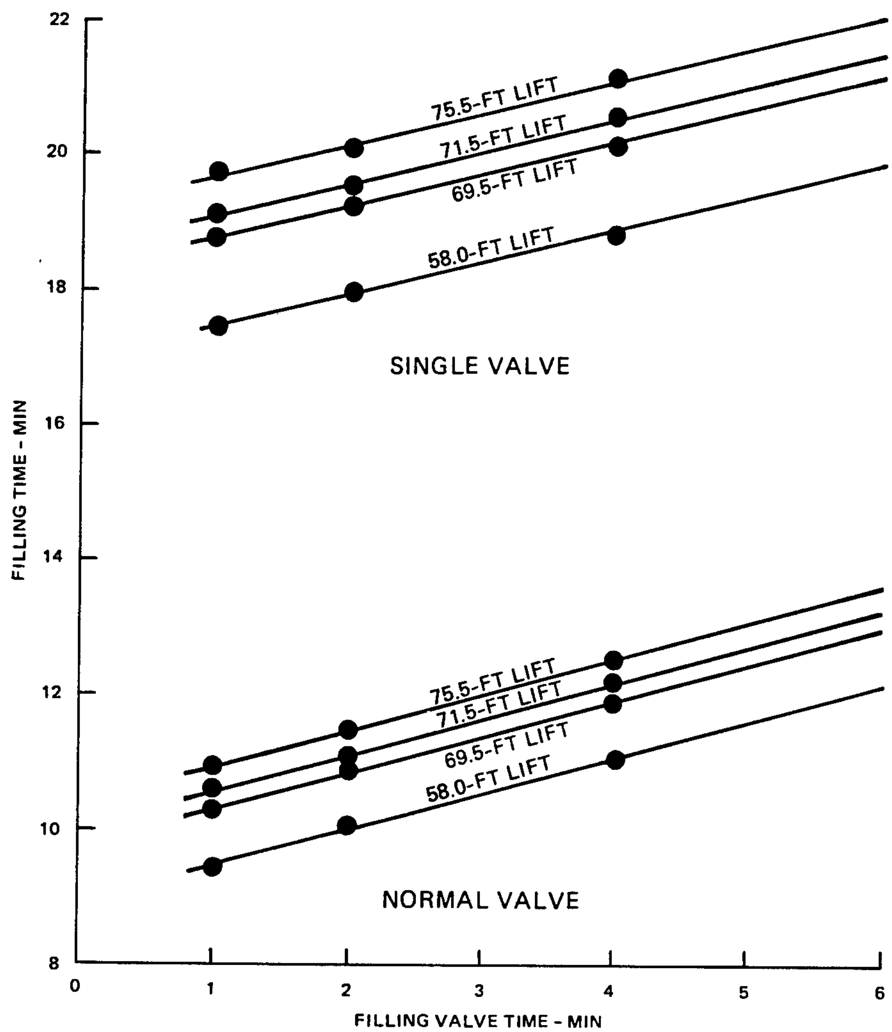
Plate 40





H PATTERN SYSTEM

TYPICAL FREE TOW MOVEMENT
DURING FILLING OPERATIONS
1-MIN NORMAL VALVE OPERATION
TYPE 1 (ORIGINAL) DESIGN



H PATTERN SYSTEM

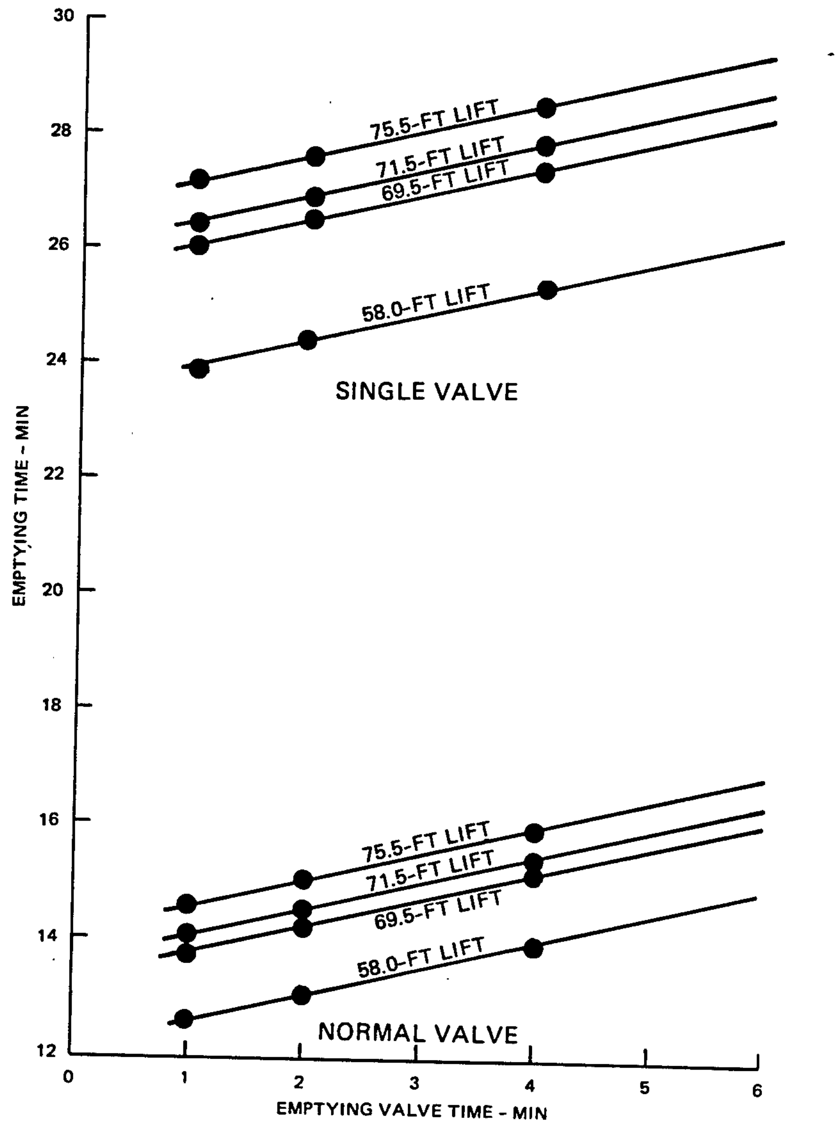
FILLING TIMES VS VALVE TIMES

TYPE 14 DESIGN

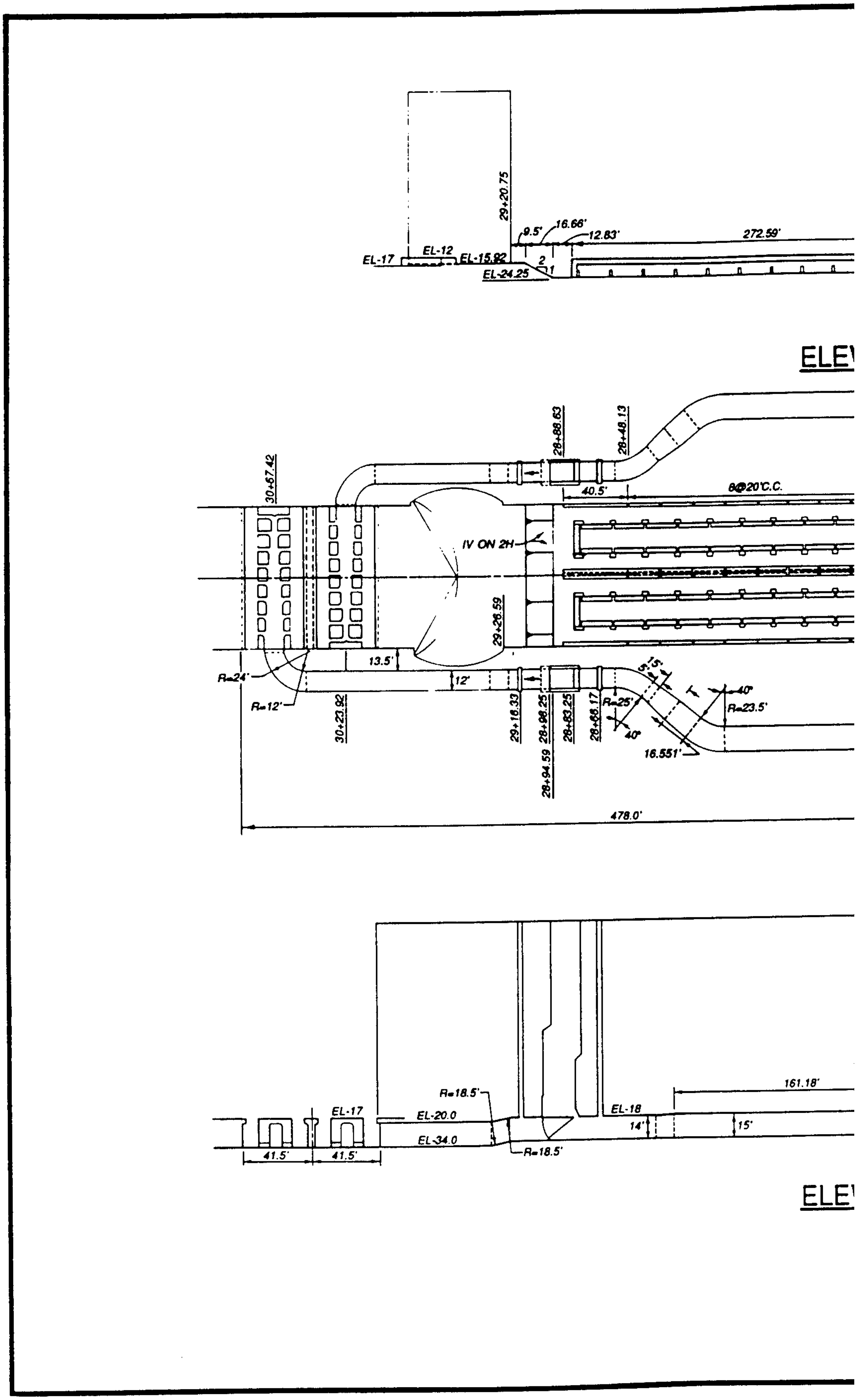
NORMAL AND SINGLE VALVE OPERATIONS

69.5-FT LIFT: U.P. 76.5 L.P. 7.0
71.5-FT LIFT: U.P. 76.5 L.P. 5.0
75.5-FT LIFT: U.P. 82.5 L.P. 7.0
58.0-FT LIFT: U.P. 74.0 L.P. 16.0

Plate 42

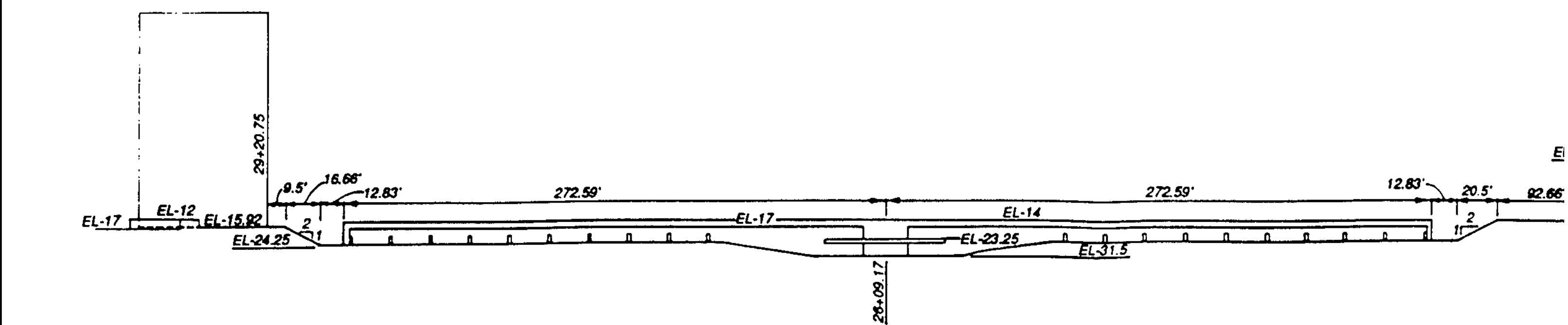


H PATTERN SYSTEM
EMPTYING TIMES VS VALVE TIMES
TYPE 14 DESIGN
NORMAL AND SINGLE VALVE OPERATIONS
69.5-FT LIFT: U.P. 76.5 L.P. 7.0
71.5-FT LIFT: U.P. 76.5 L.P. 5.0
75.5-FT LIFT: U.P. 82.5 L.P. 7.0
58.0-FT LIFT: U.P. 74.0 L.P. 16.0

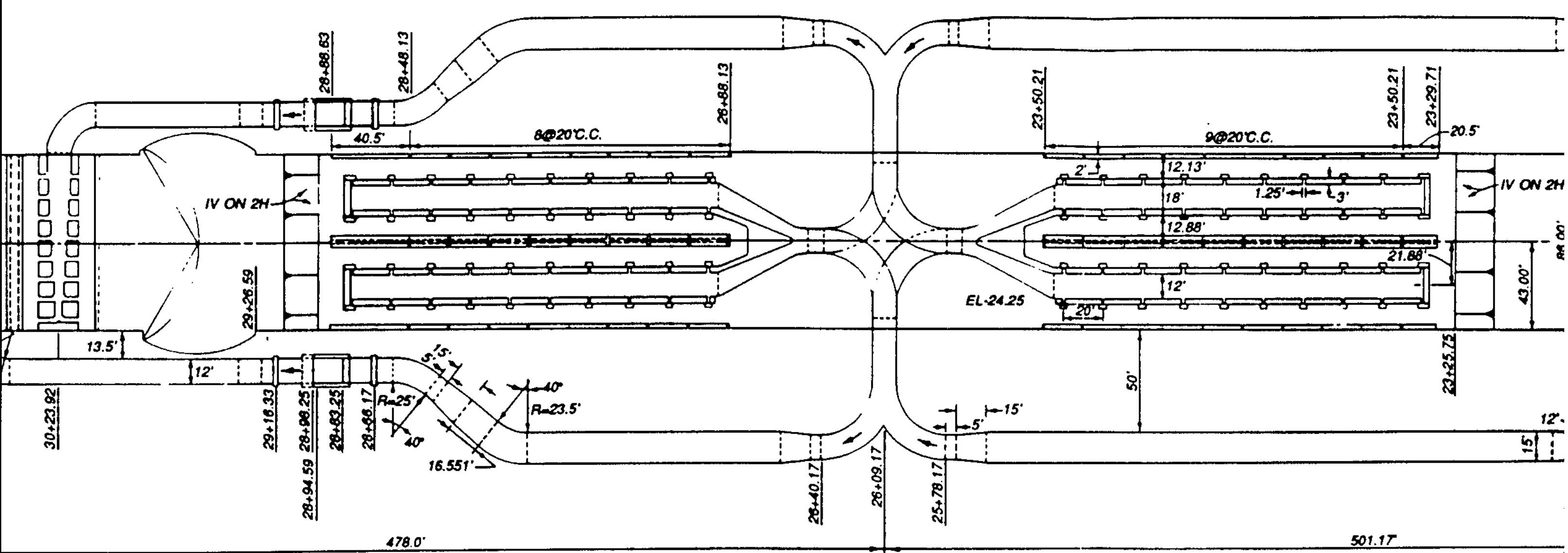


29+20.75
9.5'
16.66'
12.83'
272.59'
EL-17
EL-12
EL-15.92
EL-24.25
2
1
ELE
30+67.42
28+88.63
28+48.13
40.5'
8@20'C.C.
IV ON 2H
29+26.59
13.5'
12'
R=24'
R=12'
30+23.92
29+18.33
28+98.25
28+94.59
28+83.25
28+68.17
R=25'
15'
5'
40°
R=23.5'
16.551'
478.0'
R=18.5'
EL-17
EL-20.0
EL-34.0
EL-18
14'
15'
161.18'
41.5'
41.5'
ELE

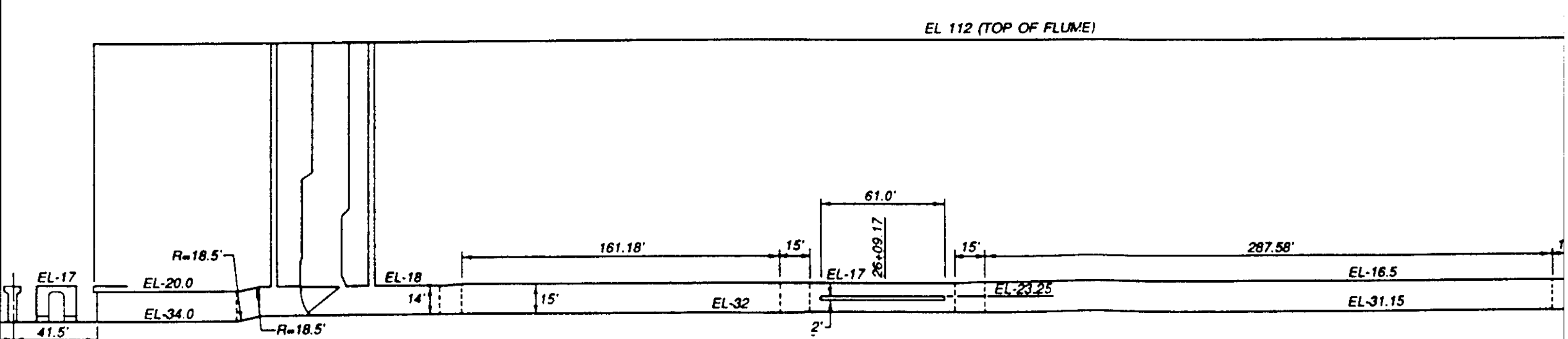
198



ELEVATION INTERIOR CULVERT



PLAN



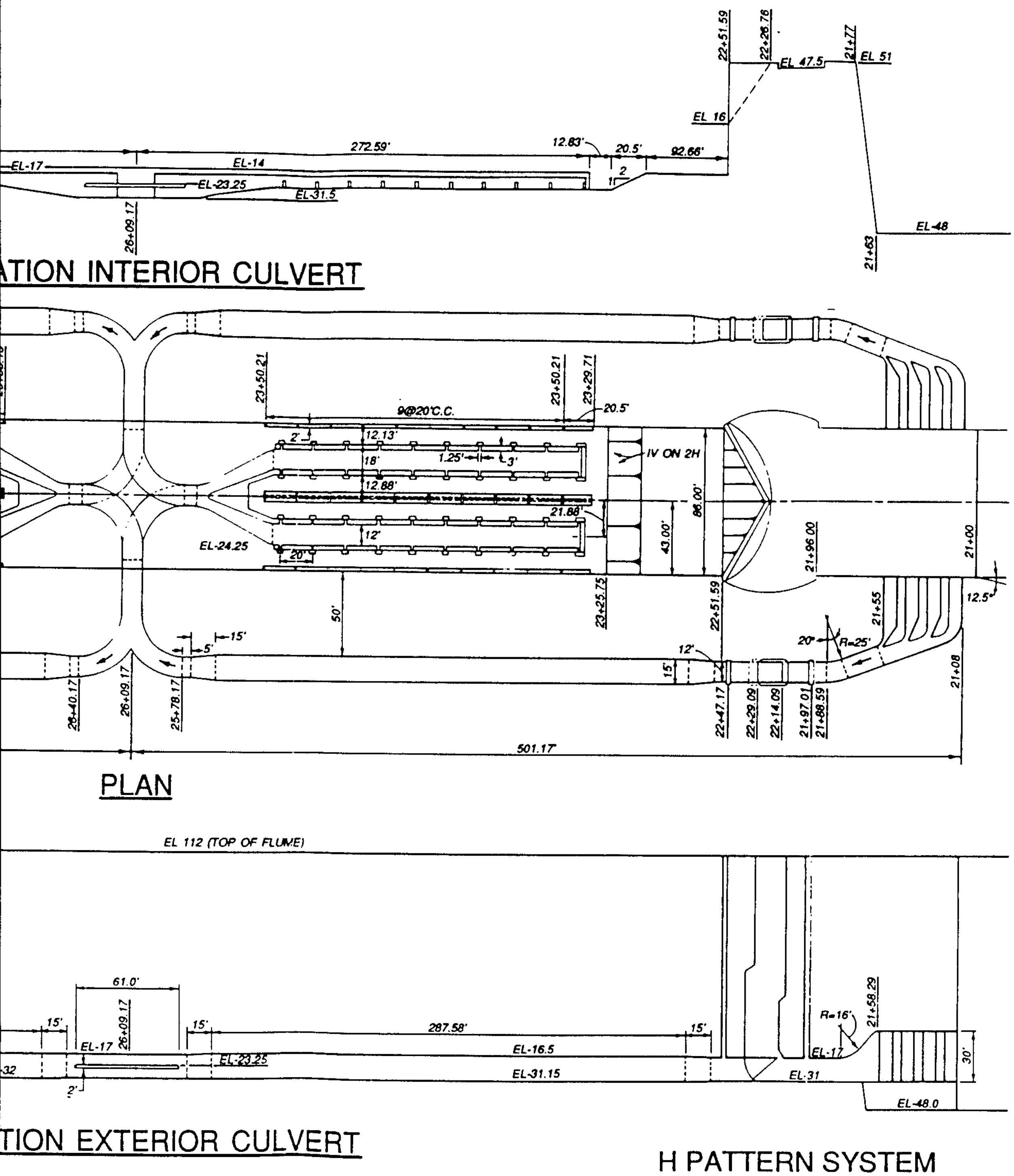
ELEVATION EXTERIOR CULVERT

H F

FILLING AN

TY

199

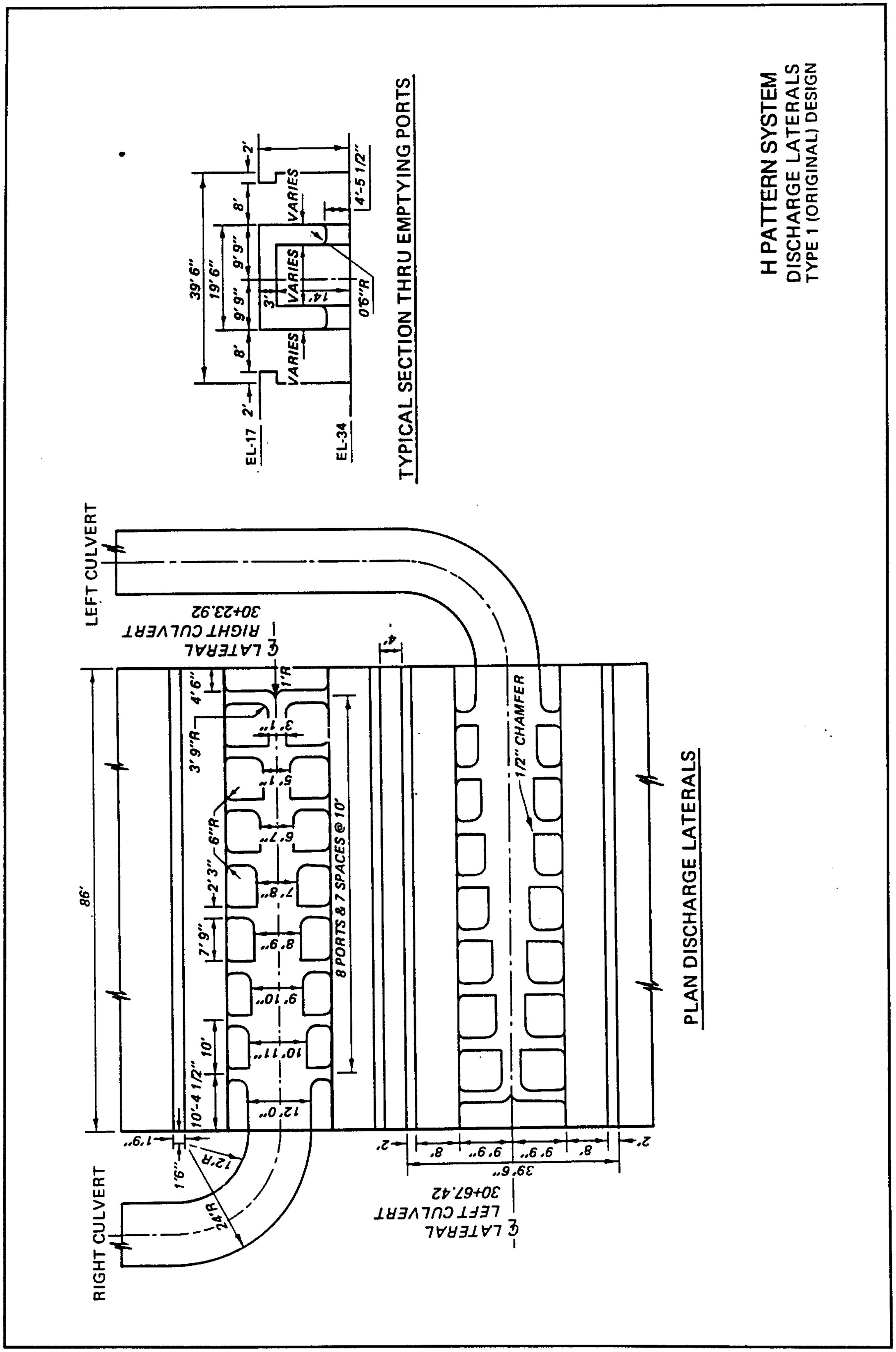


H PATTERN SYSTEM

FILLING AND EMPTYING SYSTEM

TYPE 14 DESIGN

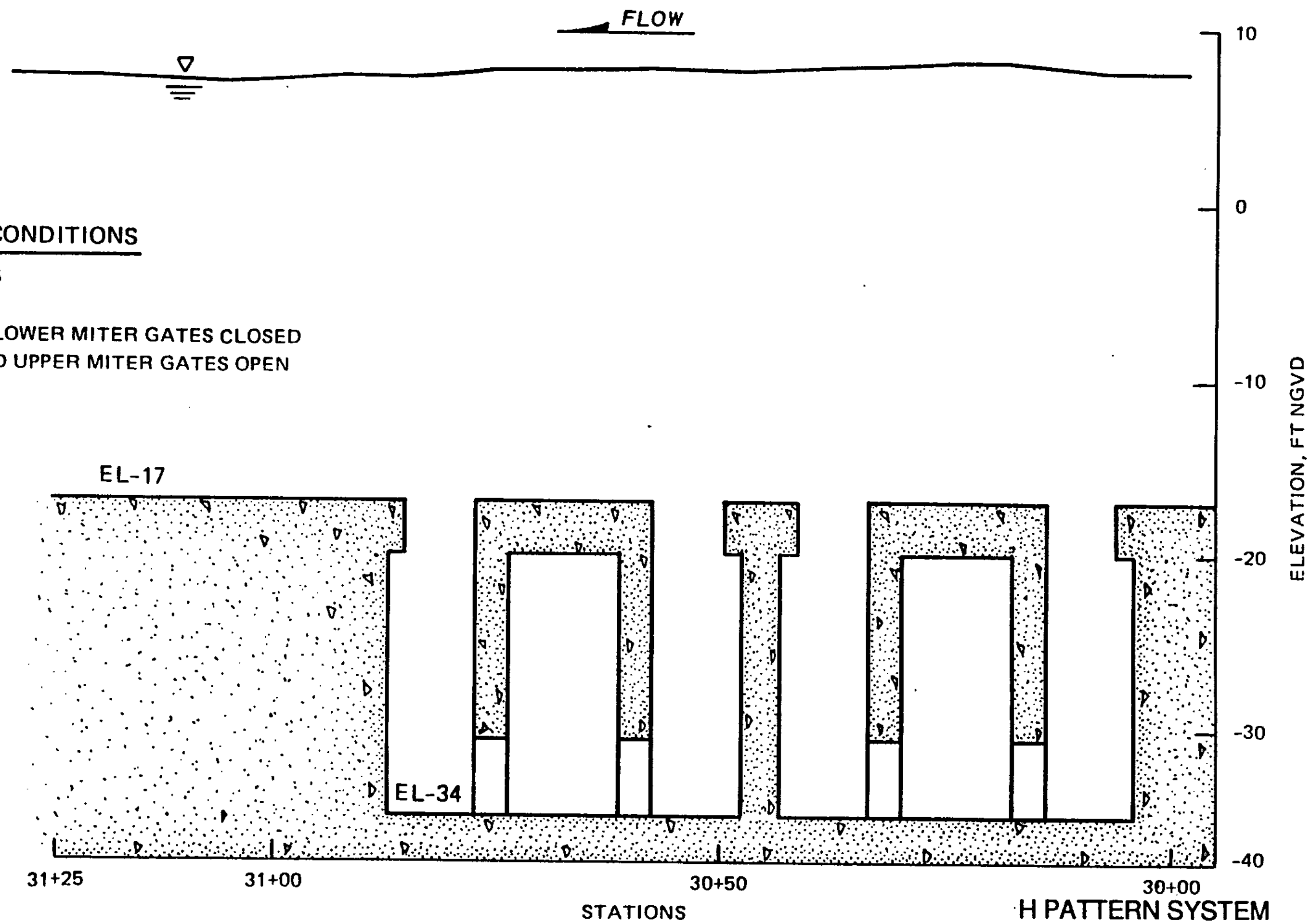
Plate 44


H PATTERN SYSTEM
DISCHARGE LATERALS
TYPE 1 (ORIGINAL) DESIGN
TYPICAL SECTION THRU EMPTYING PORTS
PLAN DISCHARGE LATERALS
LEFT CULVERT
RIGHT CULVERT
℄ LATERAL RIGHT CULVERT 30+23.92
℄ LATERAL LEFT CULVERT 30+67.42
8 PORTS & 7 SPACES @ 10'
1/2" CHAMFER
EL-17
EL-34
VARIES
0'6"R
39'6"
19'6"
86'

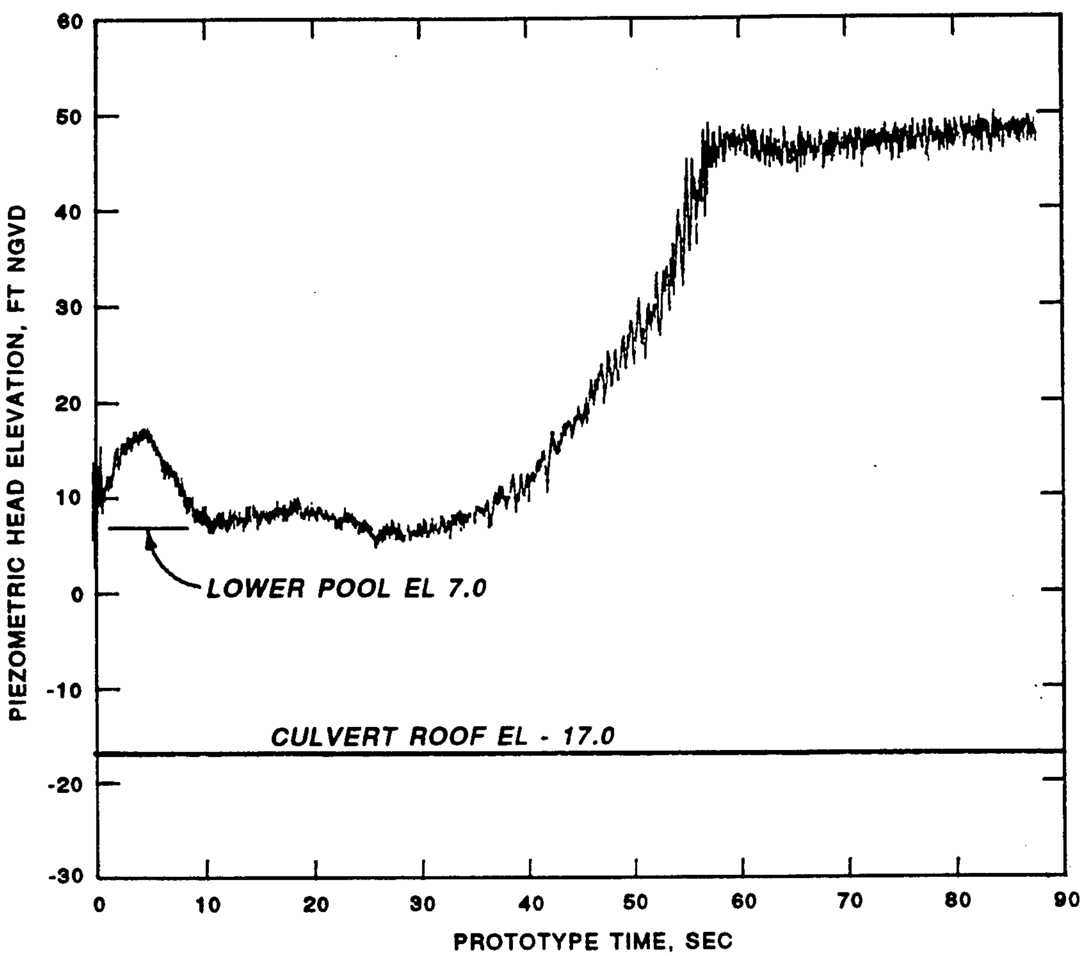
201

TEST CONDITIONS

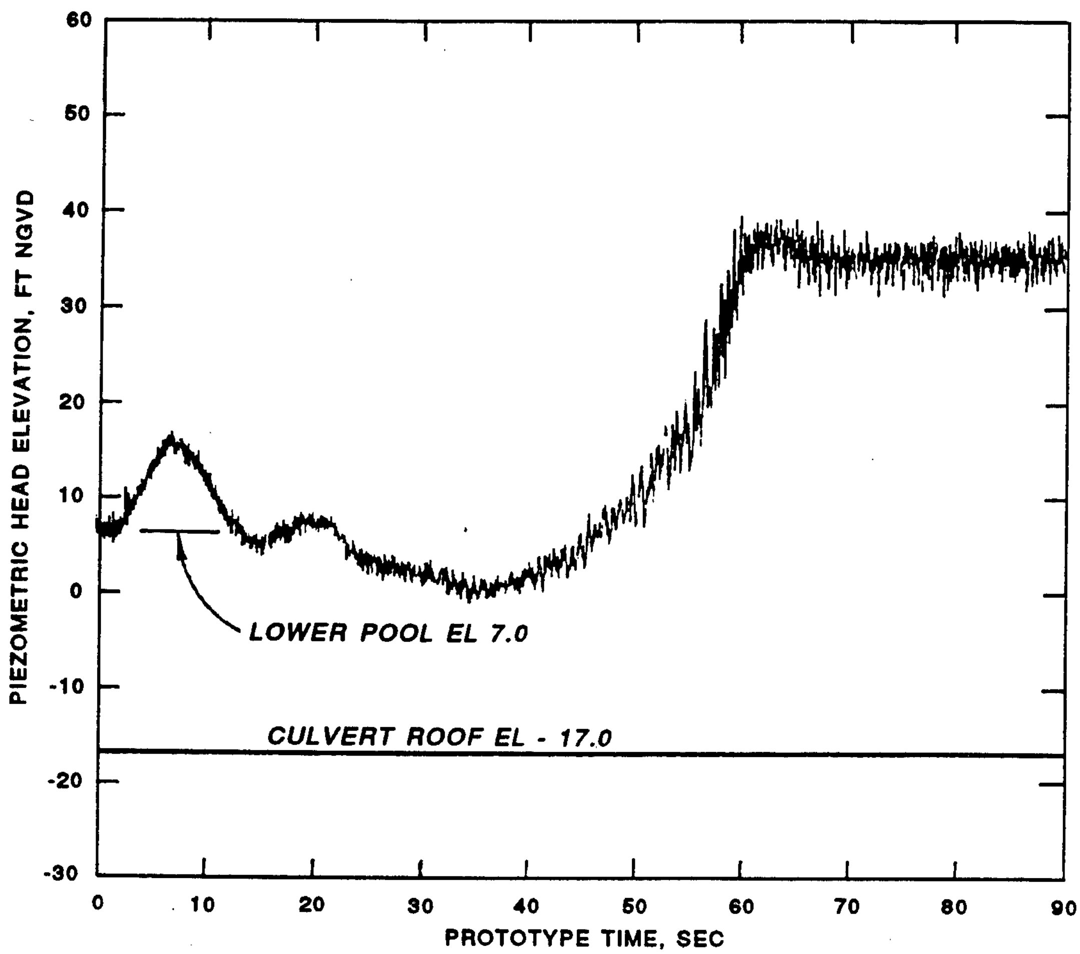
LOCK CHAMBER EL 76.5
LOWER POOL EL 7
FILLING VALVES AND LOWER MITER GATES CLOSED
EMPTYING VALVES AND UPPER MITER GATES OPEN



H PATTERN SYSTEM
WATER-SURFACE PROFILE
IN VICINITY OF THE
DISCHARGE LATERALS



H PATTERN SYSTEM
CULVERT ROOF PRESSURES
DOWNSTREAM OF FILLING VALVE
TYPE 14 DESIGN
1- MIN NORMAL VALVE OPERATION
69.5-FT LIFT



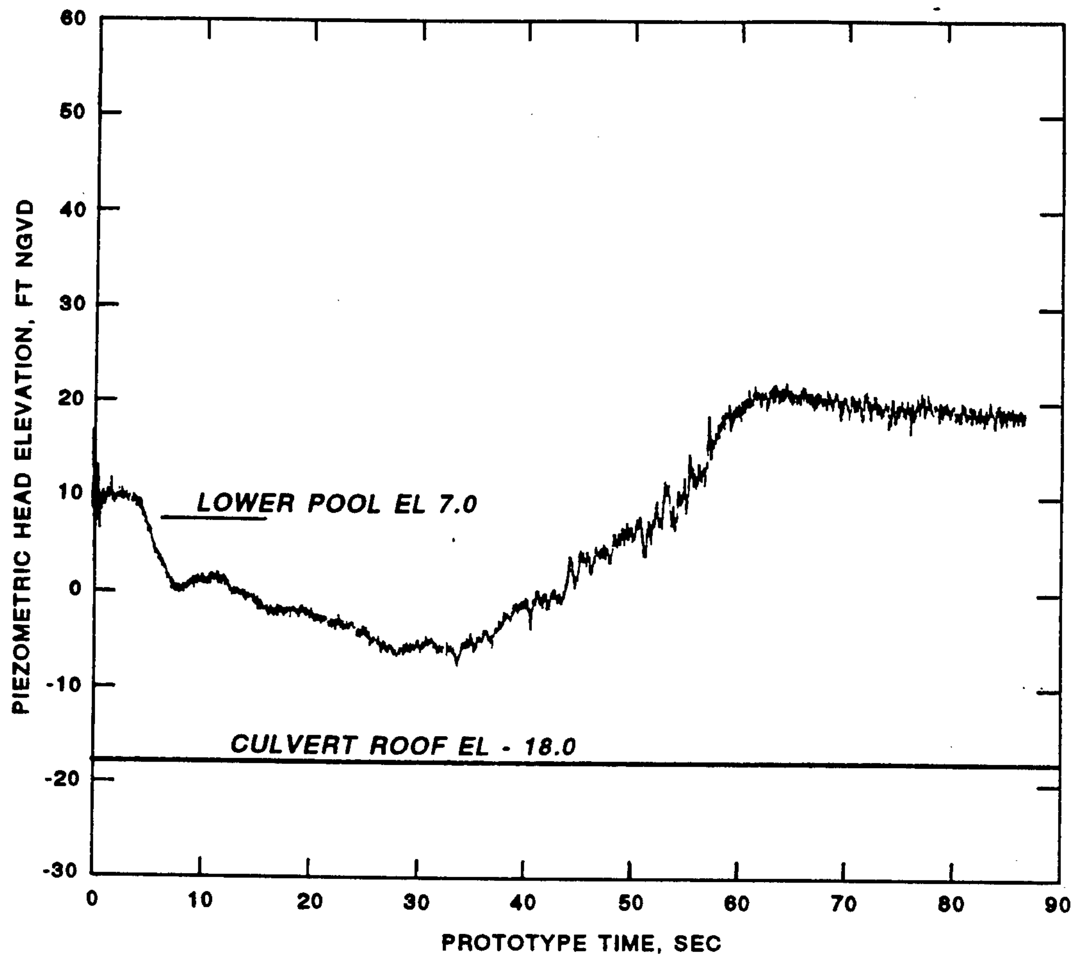
H PATTERN SYSTEM

CULVERT ROOF PRESSURES
DOWNSTREAM OF FILLING VALVE

TYPE 14 DESIGN

1- MIN SINGLE VALVE OPERATION

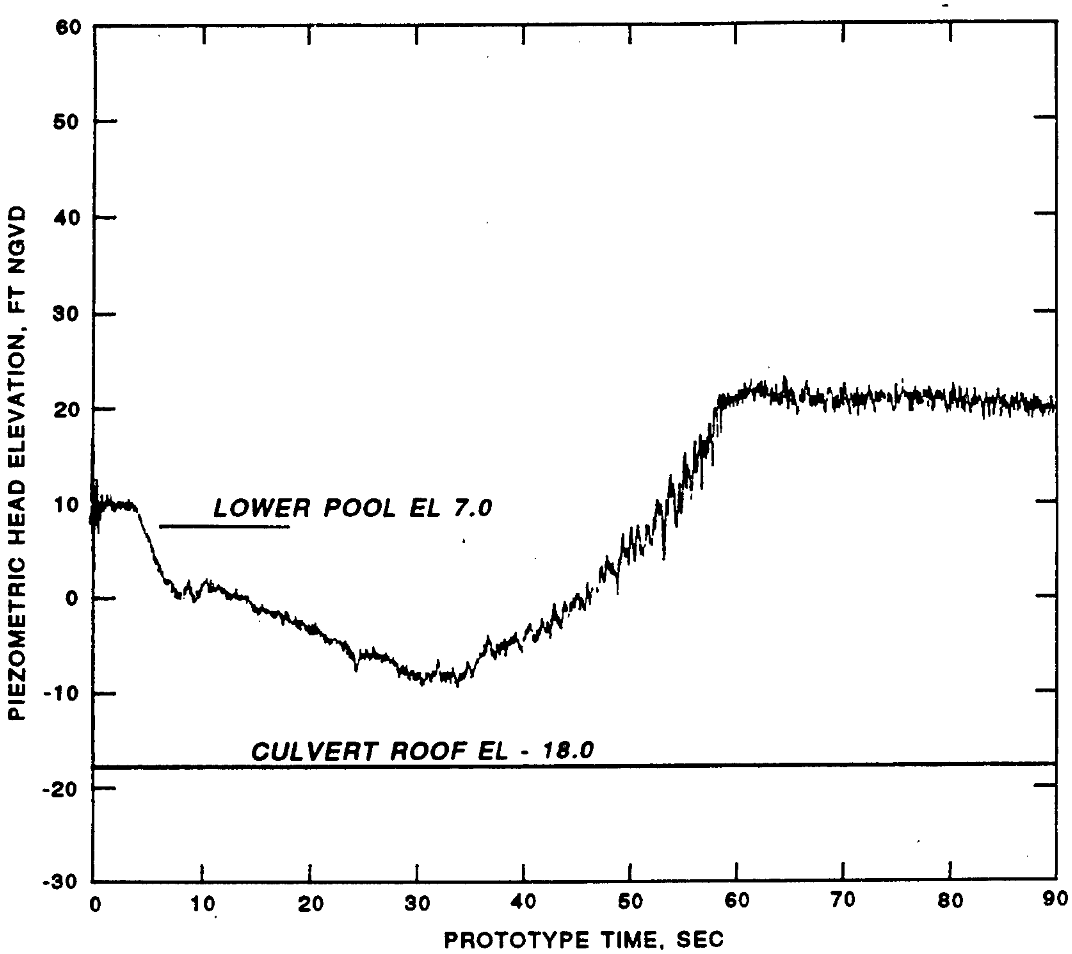
69.5-FT LIFT



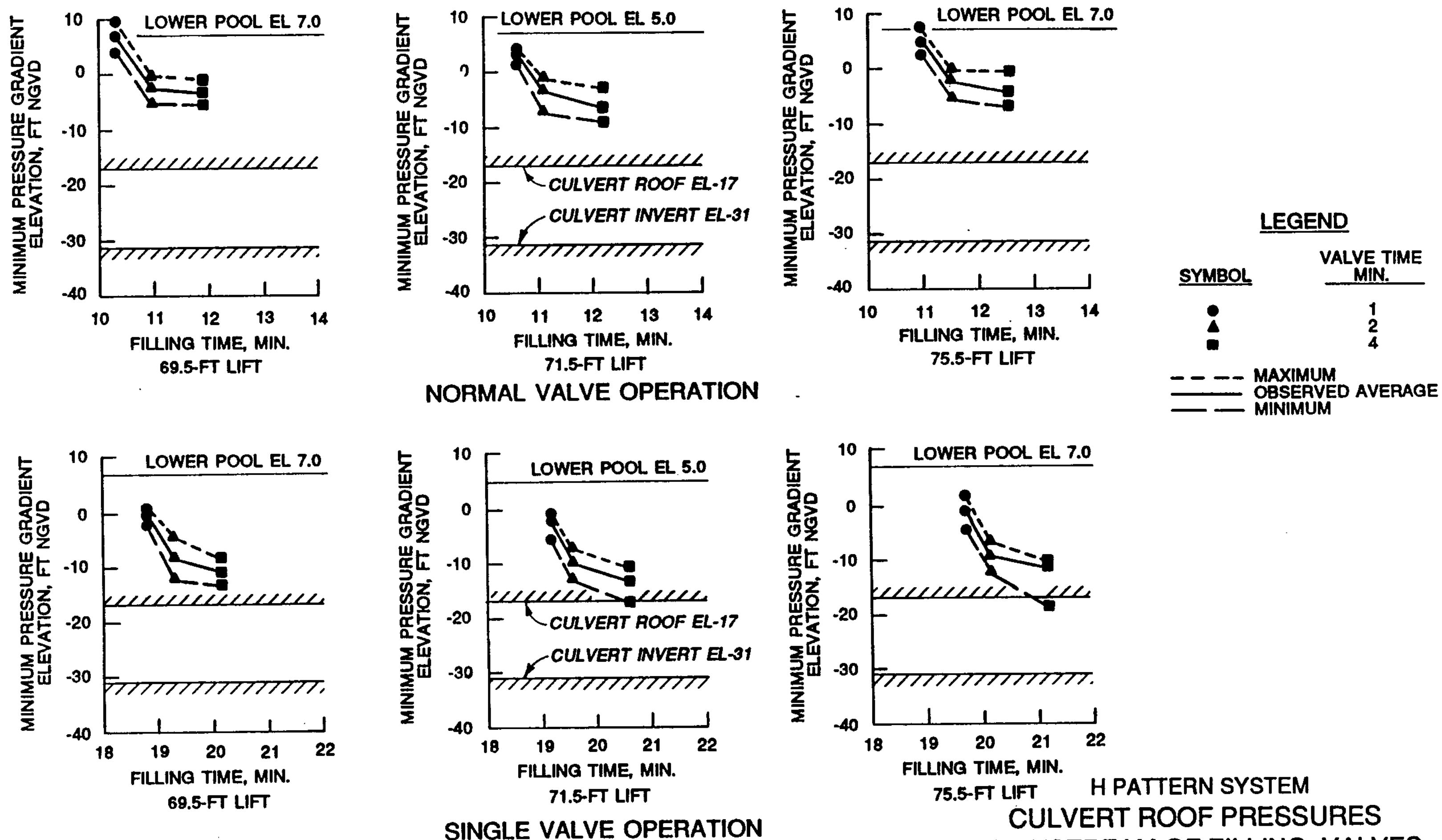
H PATTERN SYSTEM

CULVERT ROOF PRESSURES
DOWNSTREAM OF EMPTYING VALVE

TYPE 14 DESIGN
1- MIN NORMAL VALVE OPERATION
69.5-FT LIFT



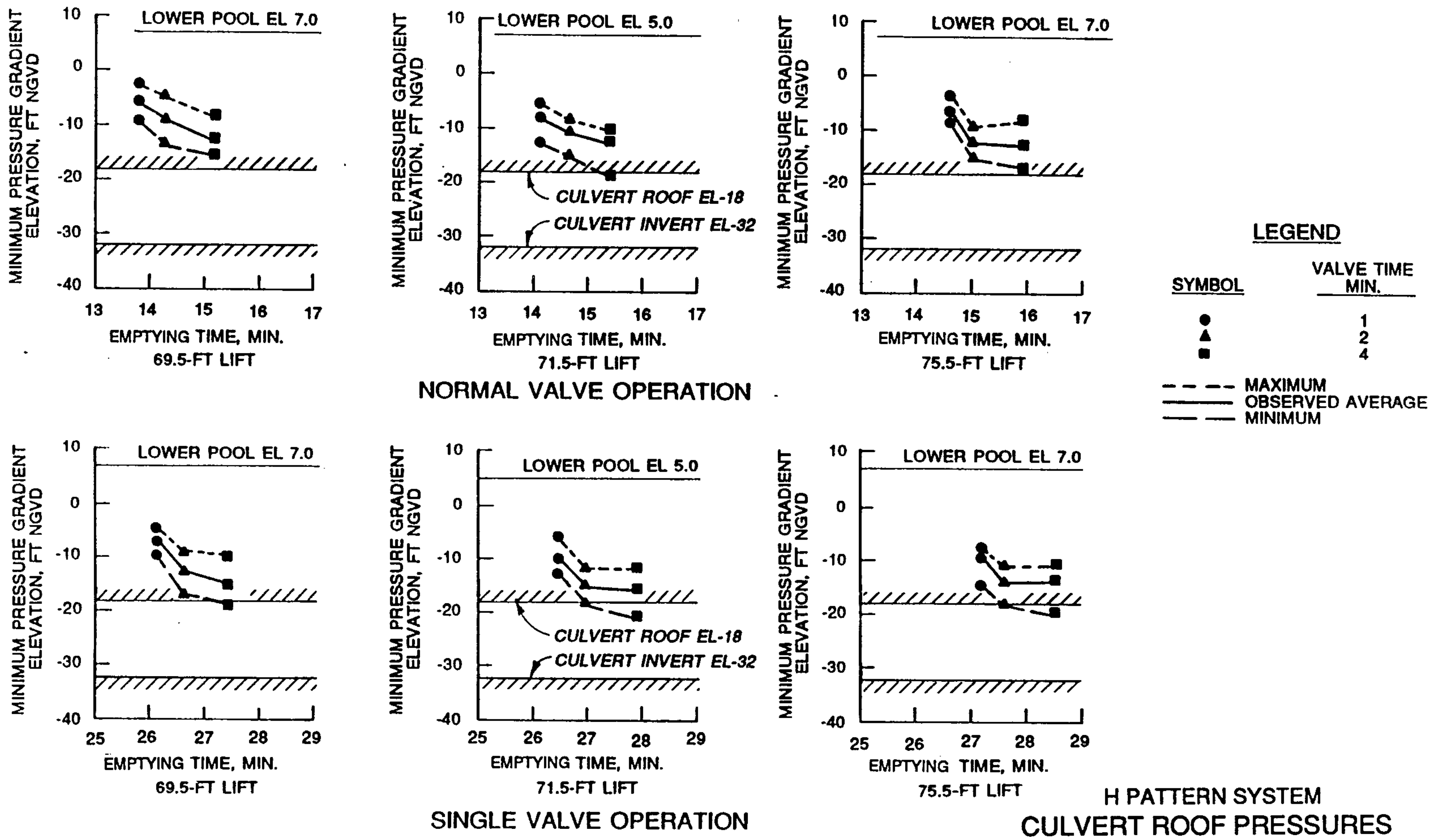
H PATTERN SYSTEM
CULVERT ROOF PRESSURES
DOWNSTREAM OF EMPTYING VALVE
TYPE 14 DESIGN
1- MIN SINGLE VALVE OPERATION
69.5-FT LIFT



H PATTERN SYSTEM

CULVERT ROOF PRESSURES
DOWNSTREAM OF FILLING VALVES
STATION 22+41.6
TYPE 14 DESIGN

207

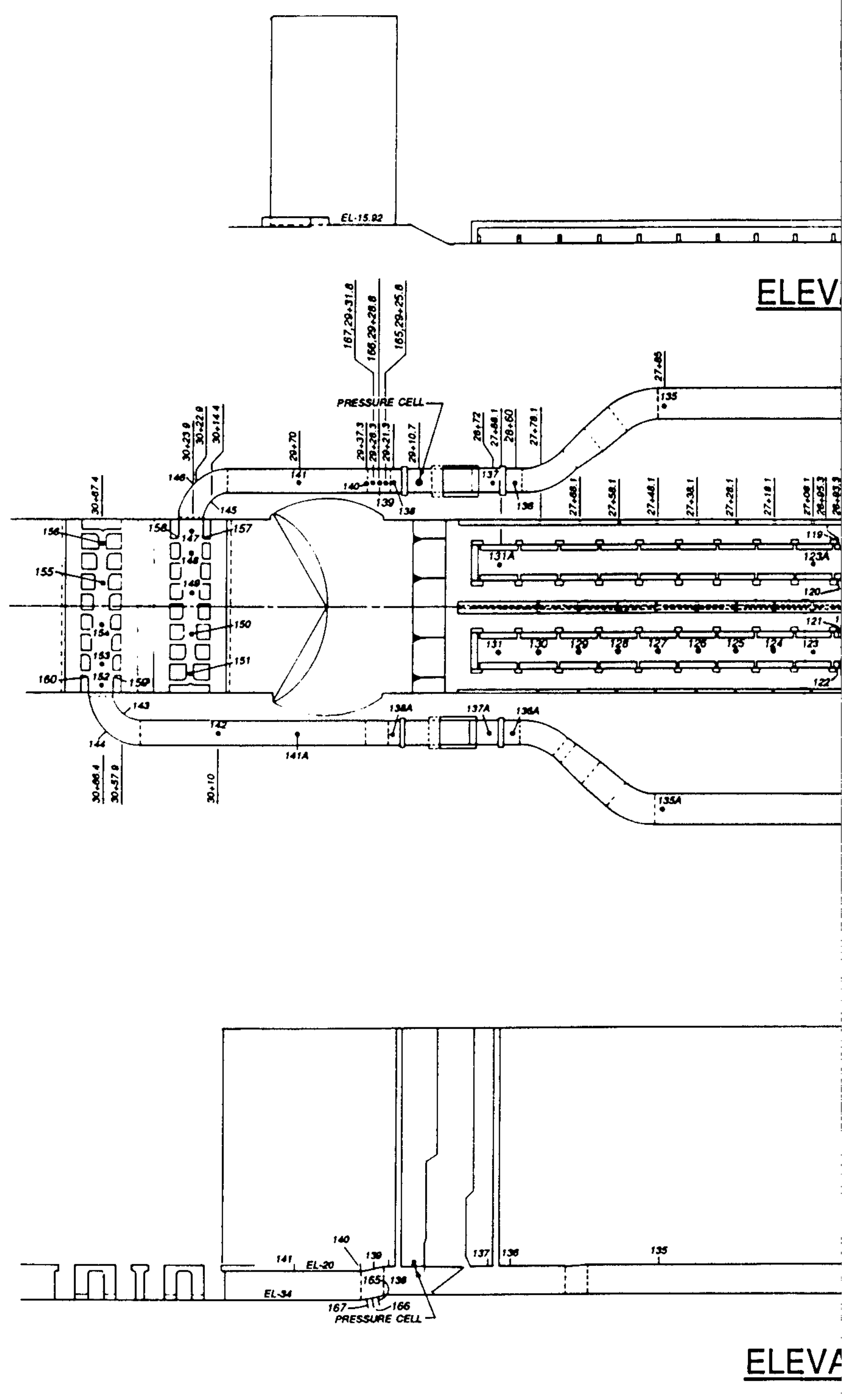


H PATTERN SYSTEM

CULVERT ROOF PRESSURES
DOWNSTREAM OF EMPTYING VALVE

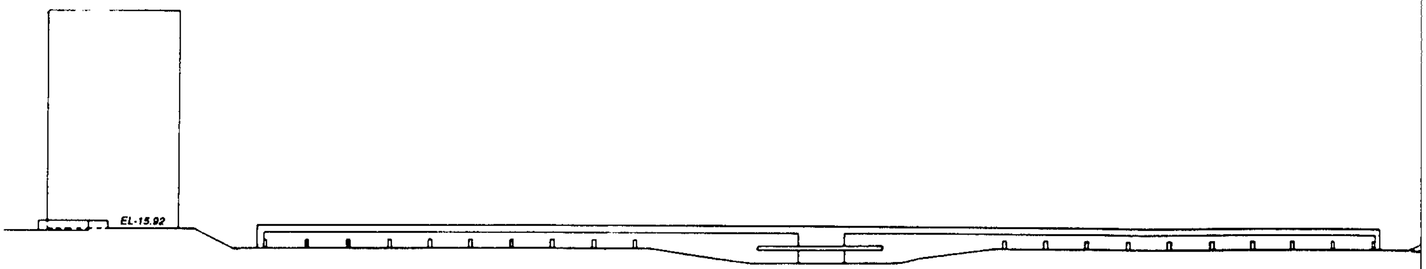
STATION 29+10.7

TYPE 14 DESIGN

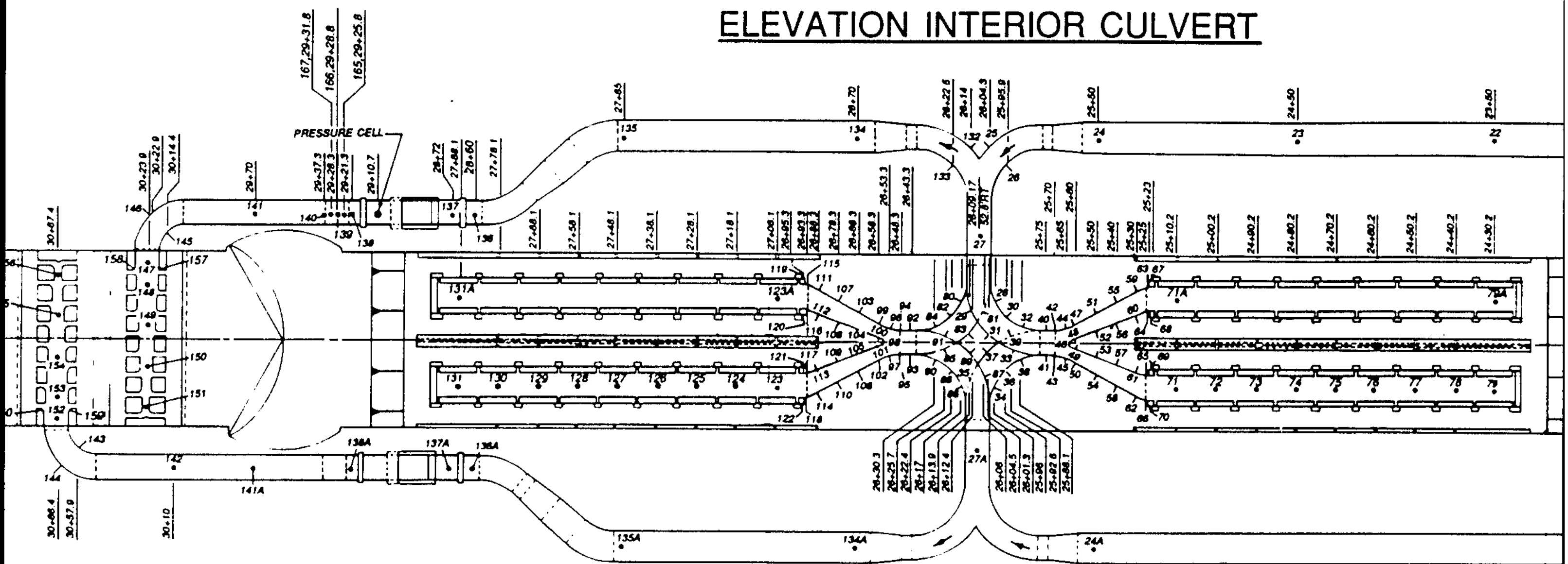


EL-15.92
ELEV
167,29+31.8
166,29+28.8
165,29+25.8
PRESSURE CELL
27+85
135
30+23.9
30+22.9
30+14.4
29+70
29+37.3
29+28.3
29+21.3
29+10.7
28+72
27+88.1
28+60
27+78.1
30+87.4
141
140
139
138
137
136
146
145
157
156
155
147
148
149
150
151
152
153
154
159
160
143
144
142
141A
138A
137A
136A
135A
131A
131
130
129
128
127
126
125
124
123
123A
119
120
121
122
27+68.1
27+58.1
27+48.1
27+38.1
27+28.1
27+18.1
27+08.1
26+95.3
26+83.3
30+86.4
30+57.9
30+10
141
EL-20
EL-34
165
167
166
PRESSURE CELL
ELEV

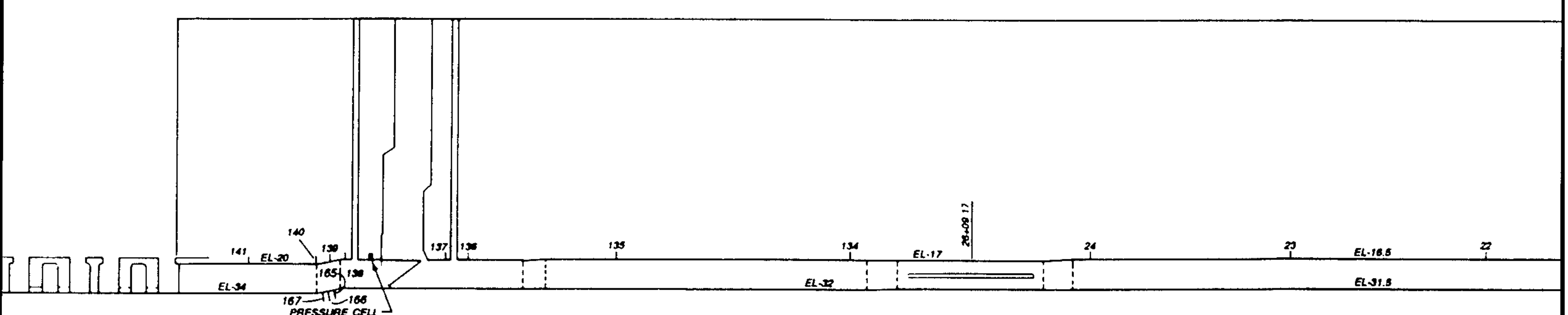
209



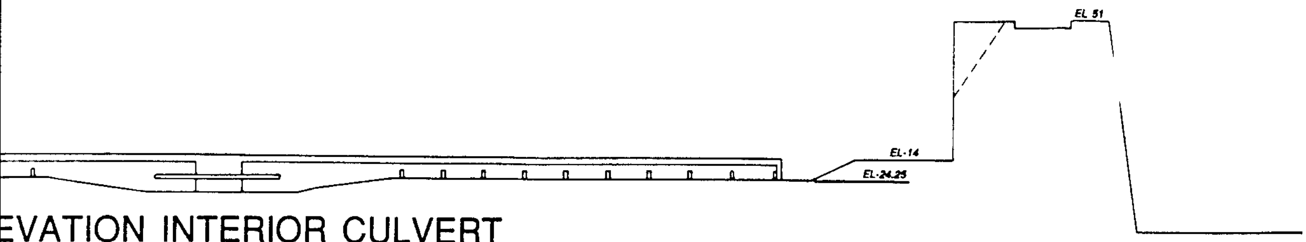
ELEVATION INTERIOR CULVERT



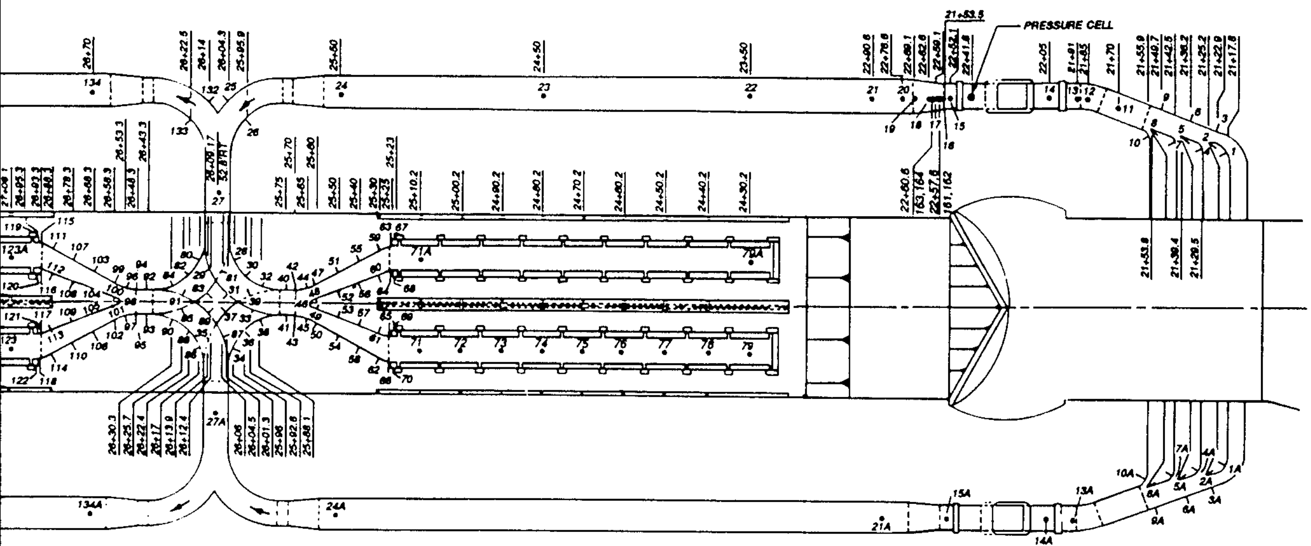
PLAN



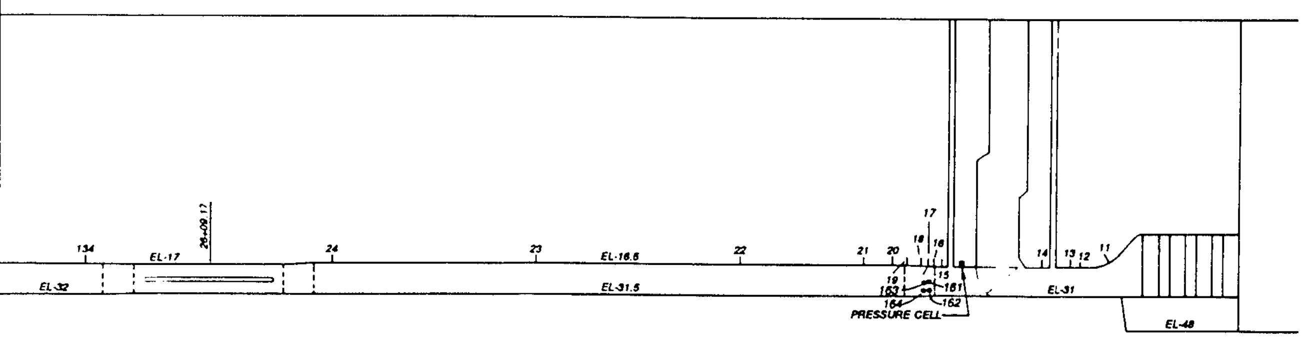
ELEVATION EXTERIOR CULVERT



EVATION INTERIOR CULVERT



PLAN



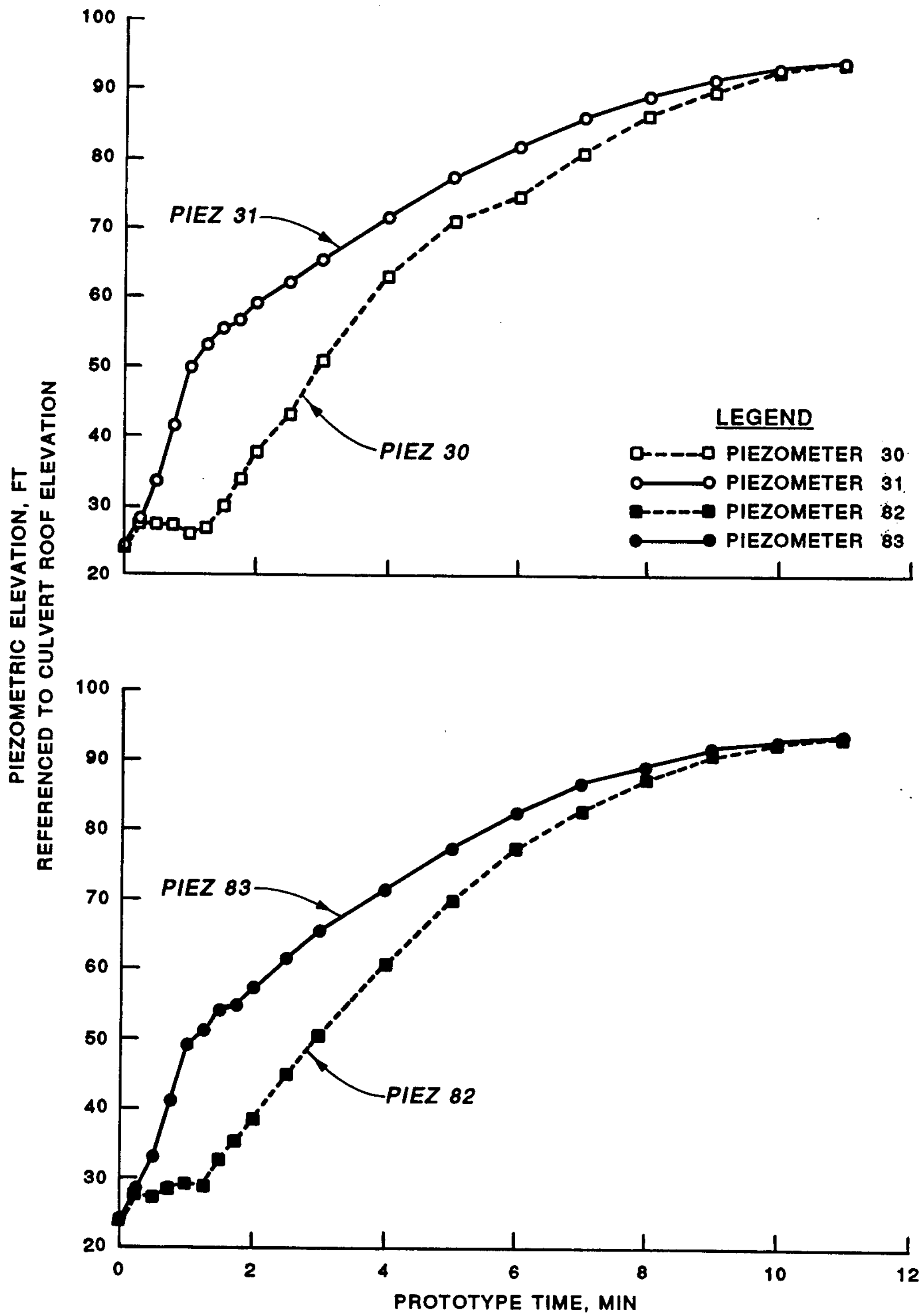
VATION EXTERIOR CULVERT

H PATTERN SYSTEM

PIEZOMETER LOCATIONS

TYPE 14 DESIGN

FILLING AND EMPTYING SYSTEM

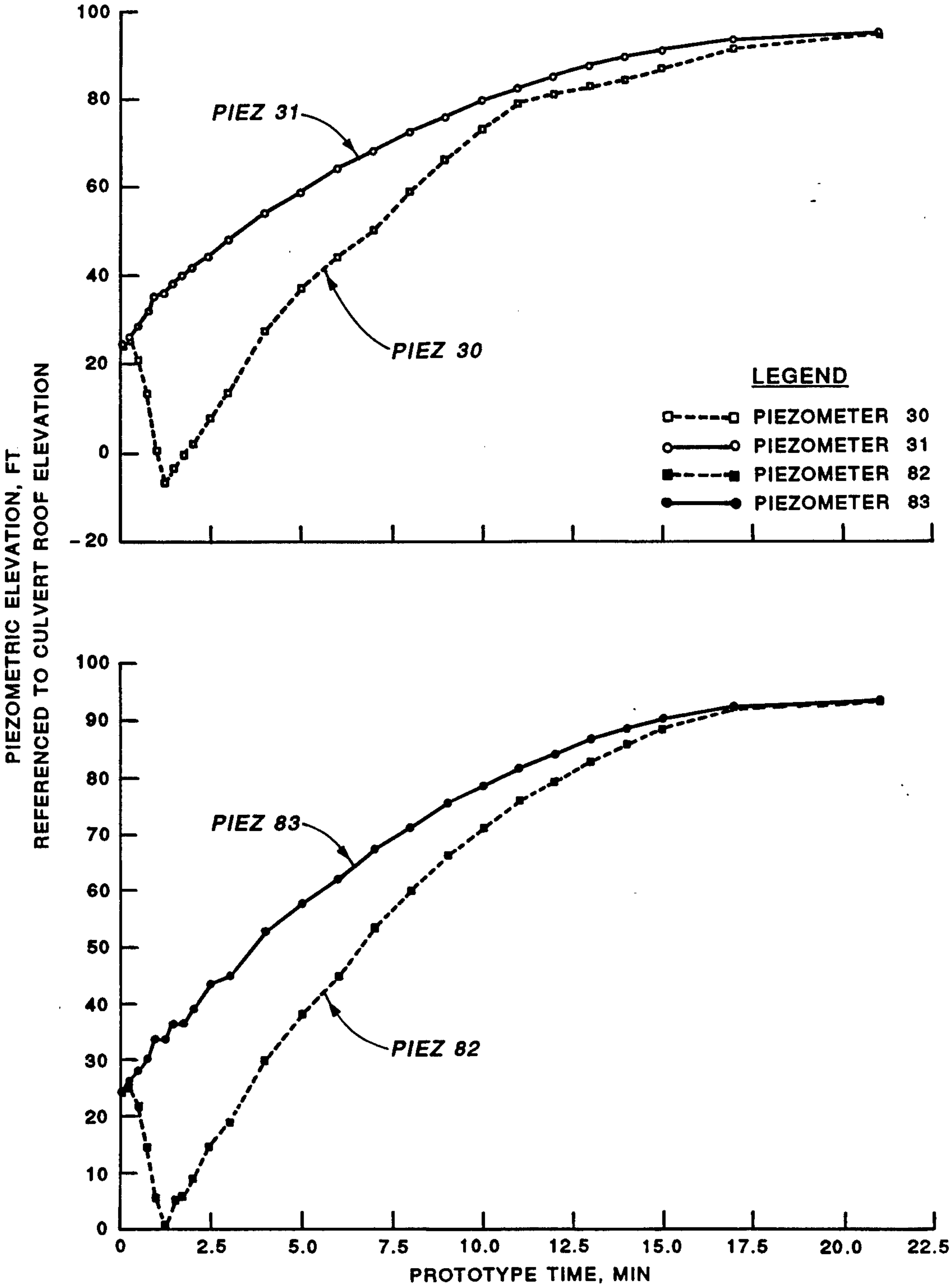


H PATTERN SYSTEM

PRESSURES IN CROSSOVER CULVERT DURING FILLING

TYPE 14 DESIGN

1- MIN NORMAL VALVE



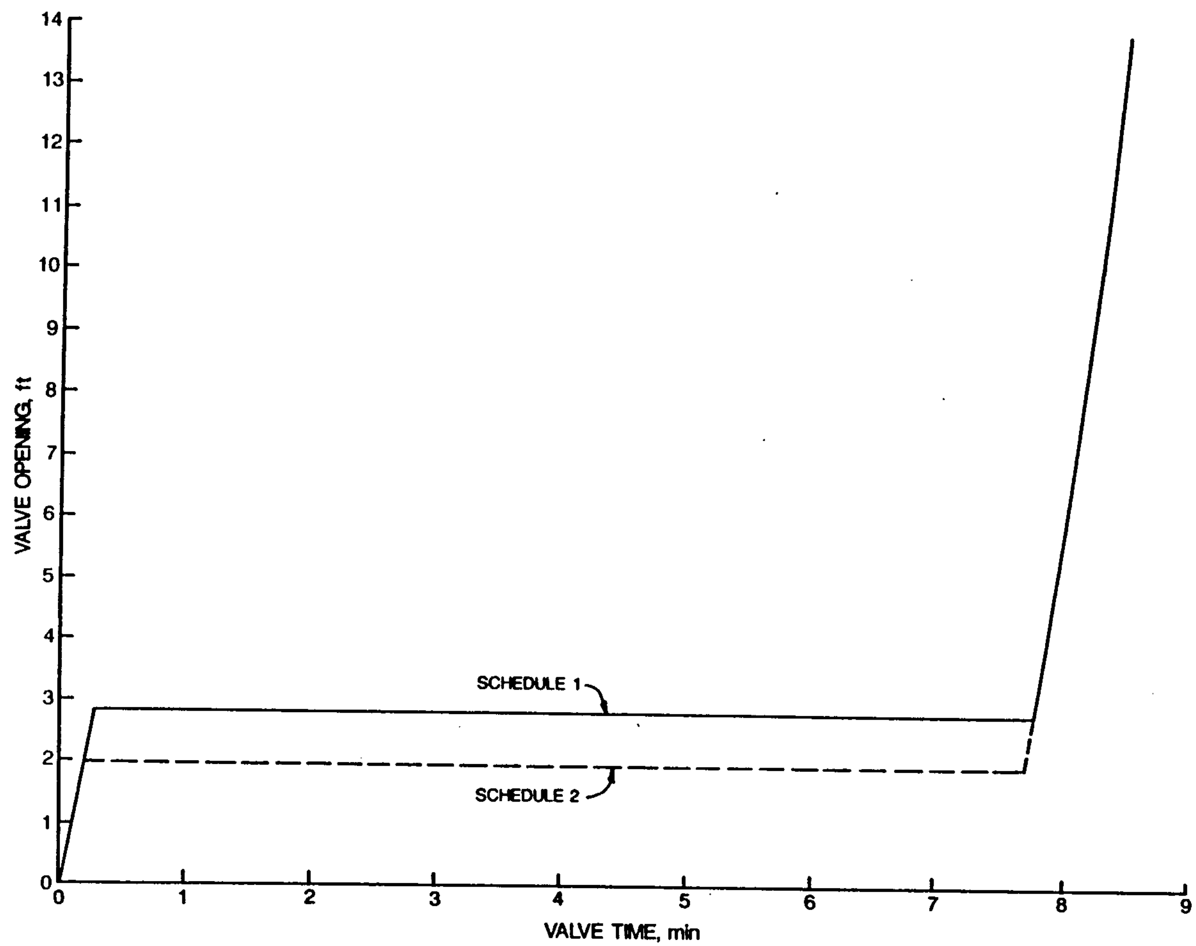
H PATTERN SYSTEM

PRESSURES IN CROSSOVER CULVERT DURING FILLING

TYPE 14 DESIGN

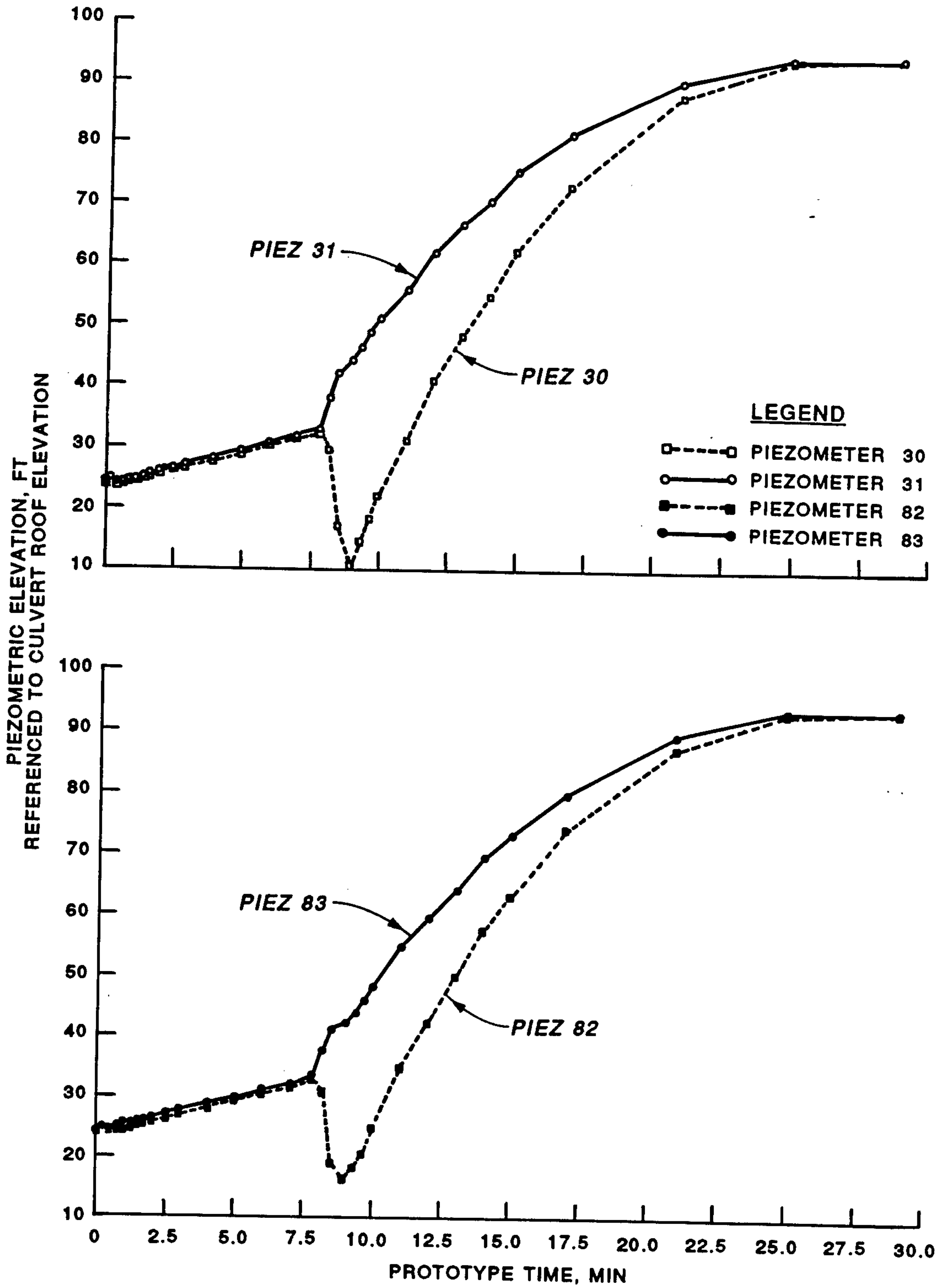
1- MIN RIGHT SINGLE VALVE

213



NOTE: STEPPED-VALVE SCHEDULES WERE USED ONLY IN SINGLE-VALVE FILLING TESTS

H PATTERN SYSTEM
STEPPED-VALVE
OPENING SCHEDULES
TYPE 14 DESIGN

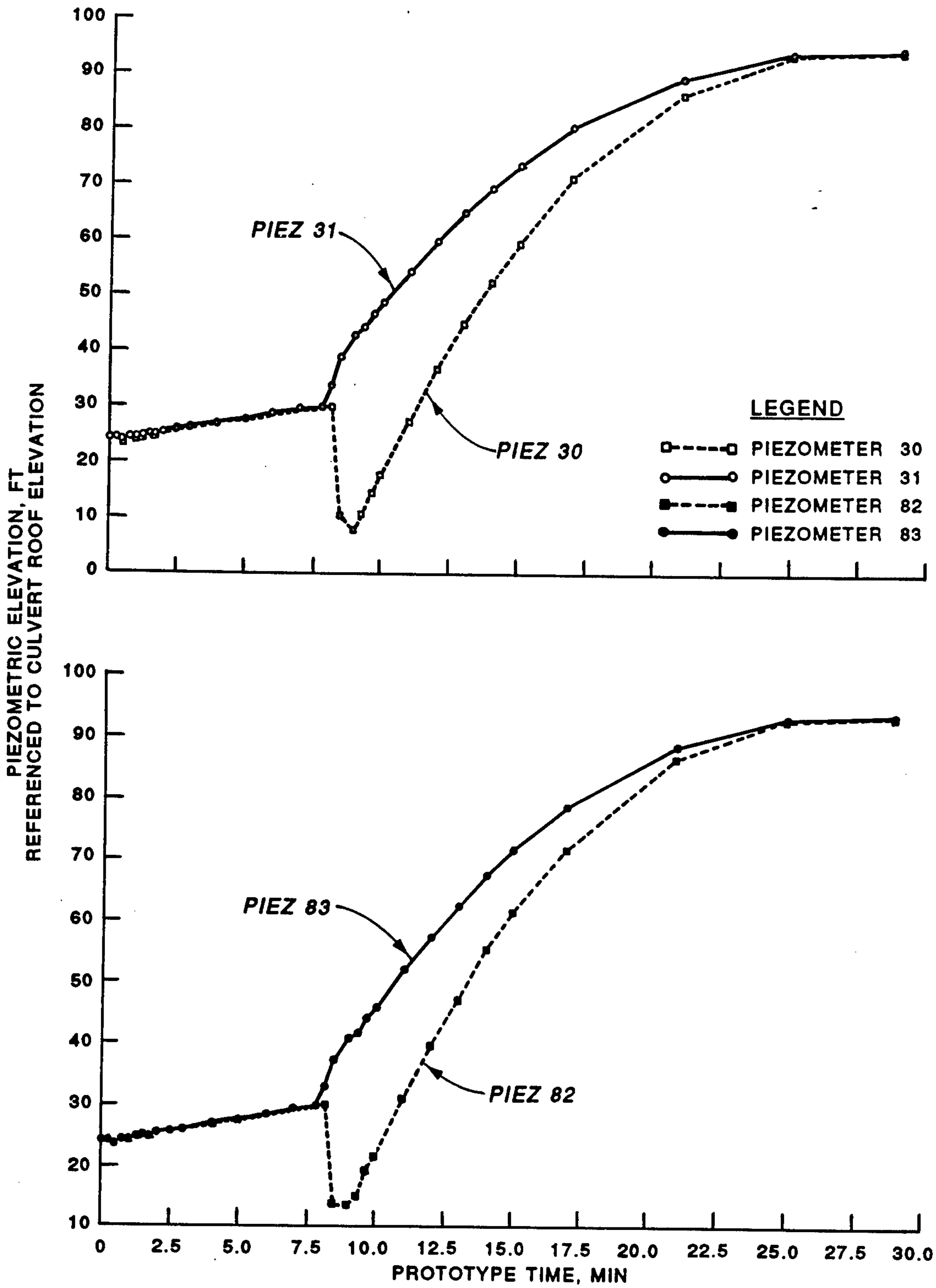


H PATTERN SYSTEM

PRESSURES IN CROSSOVER CULVERT DURING FILLING

TYPE 14 DESIGN

STEPPED-VALVE SCHEDULE 1

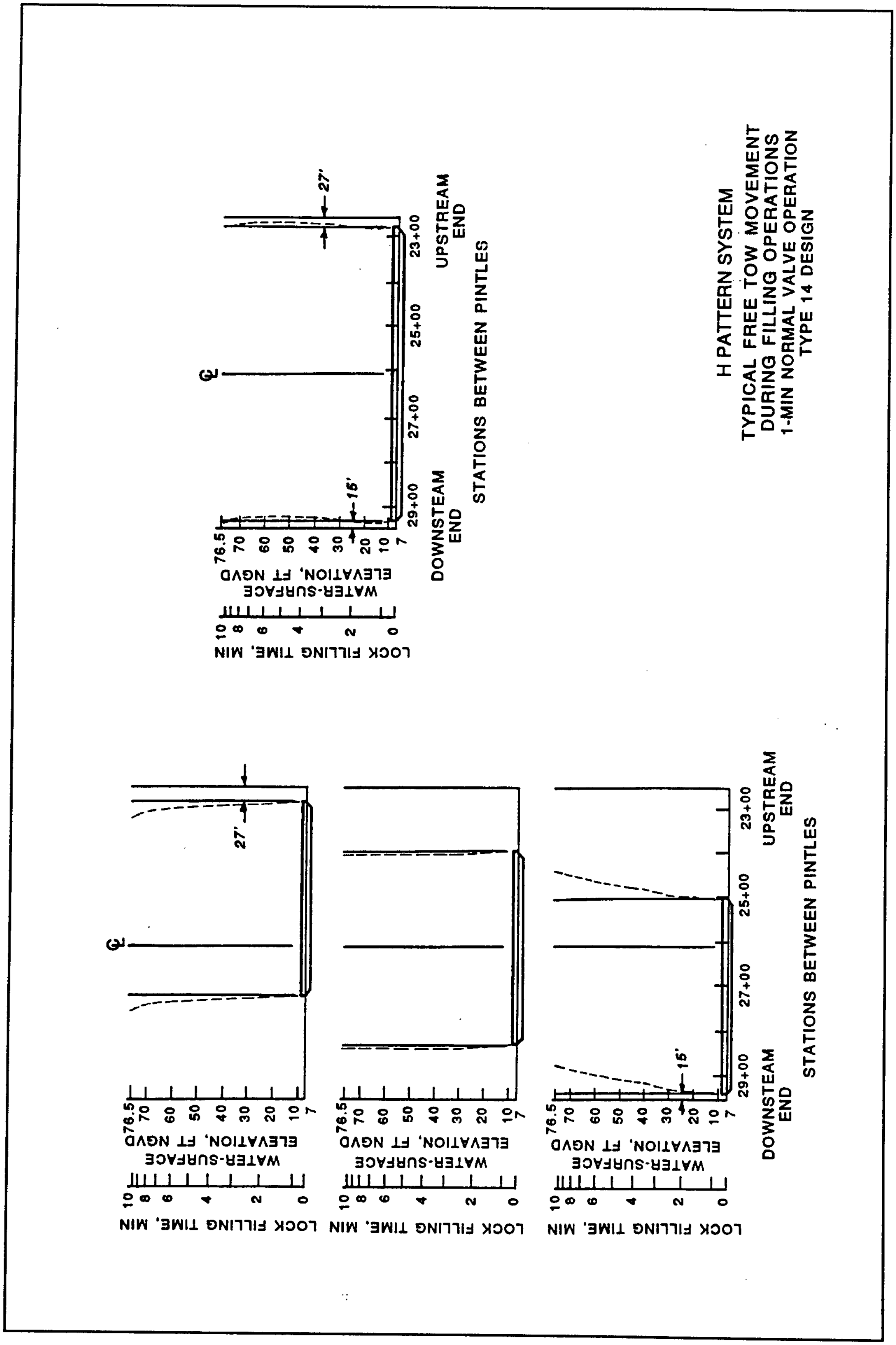


H PATTERN SYSTEM

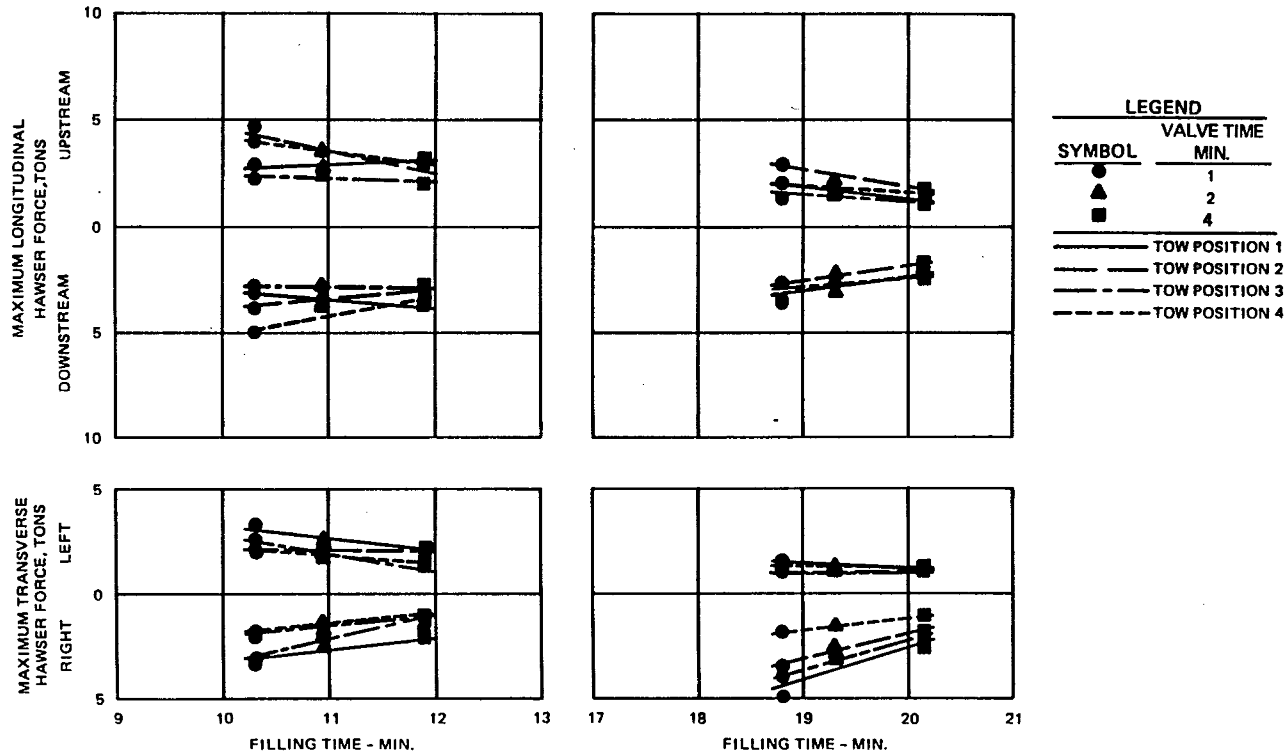
PRESSURES IN CROSSOVER CULVERT DURING FILLING

TYPE 14 DESIGN

STEPPED-VALVE SCHEDULE 2



H PATTERN SYSTEM
TYPICAL FREE TOW MOVEMENT
DURING FILLING OPERATIONS
1-MIN NORMAL VALVE OPERATION
TYPE 14 DESIGN

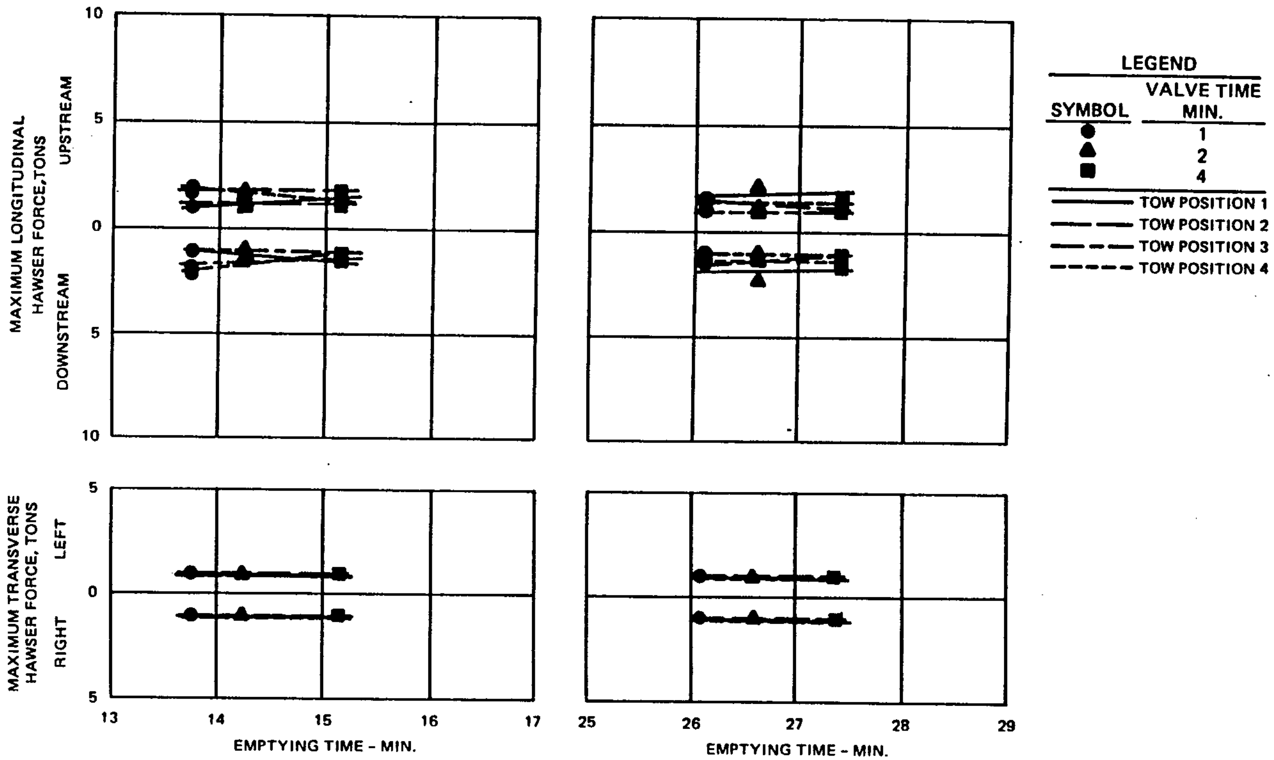


NORMAL VALVE OPERATIONS

(RIGHT) SINGLE VALVE OPERATIONS

H PATTERN SYSTEM

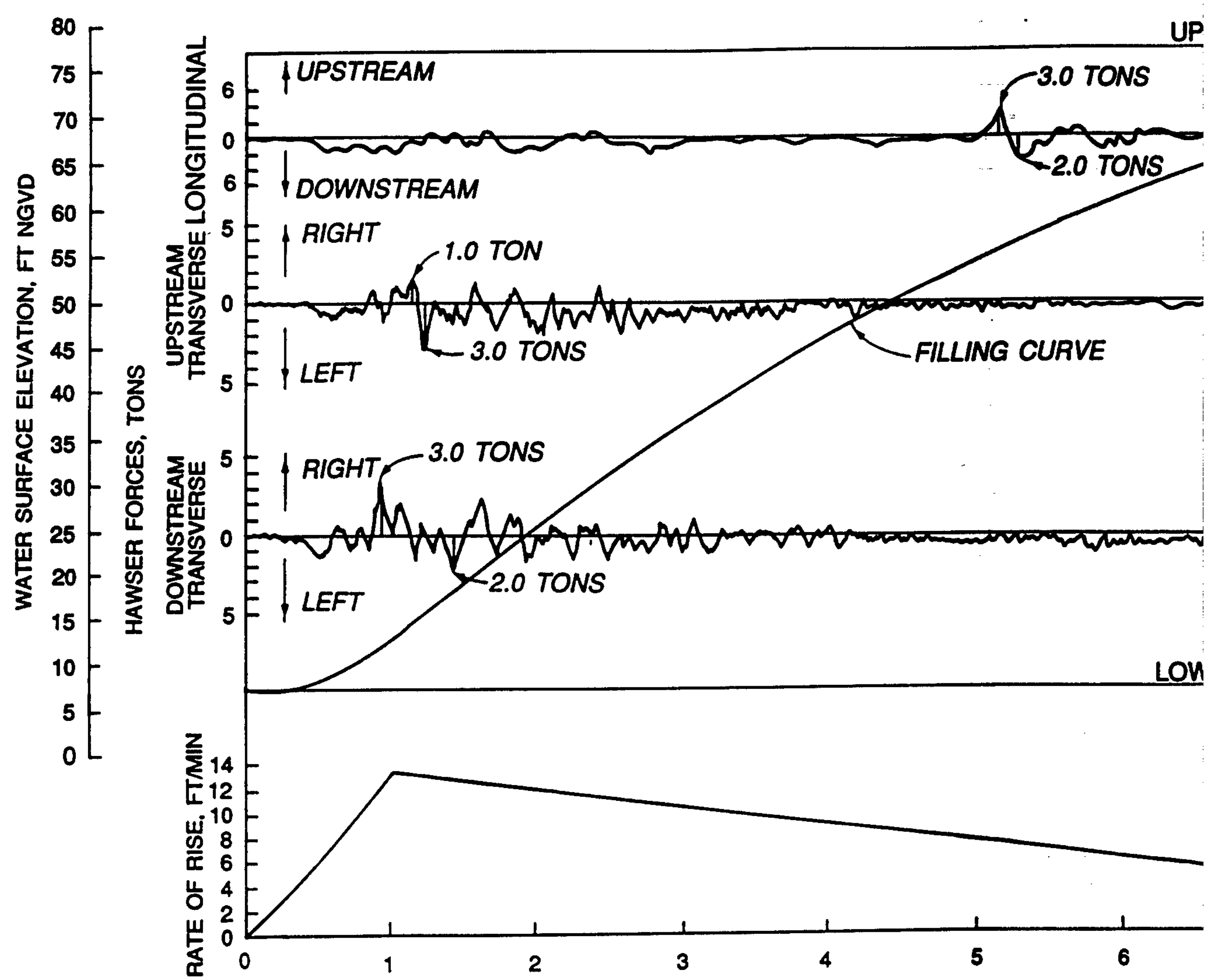
MAXIMUM HAWSER FORCES
DURING FILLING OPERATIONS
TYPE 14 DESIGN
69.5-FT LIFT
U. P. 76.5
L. P. 7.0



NORMAL VALVE OPERATIONS

(RIGHT) SINGLE VALVE OPERATIONS

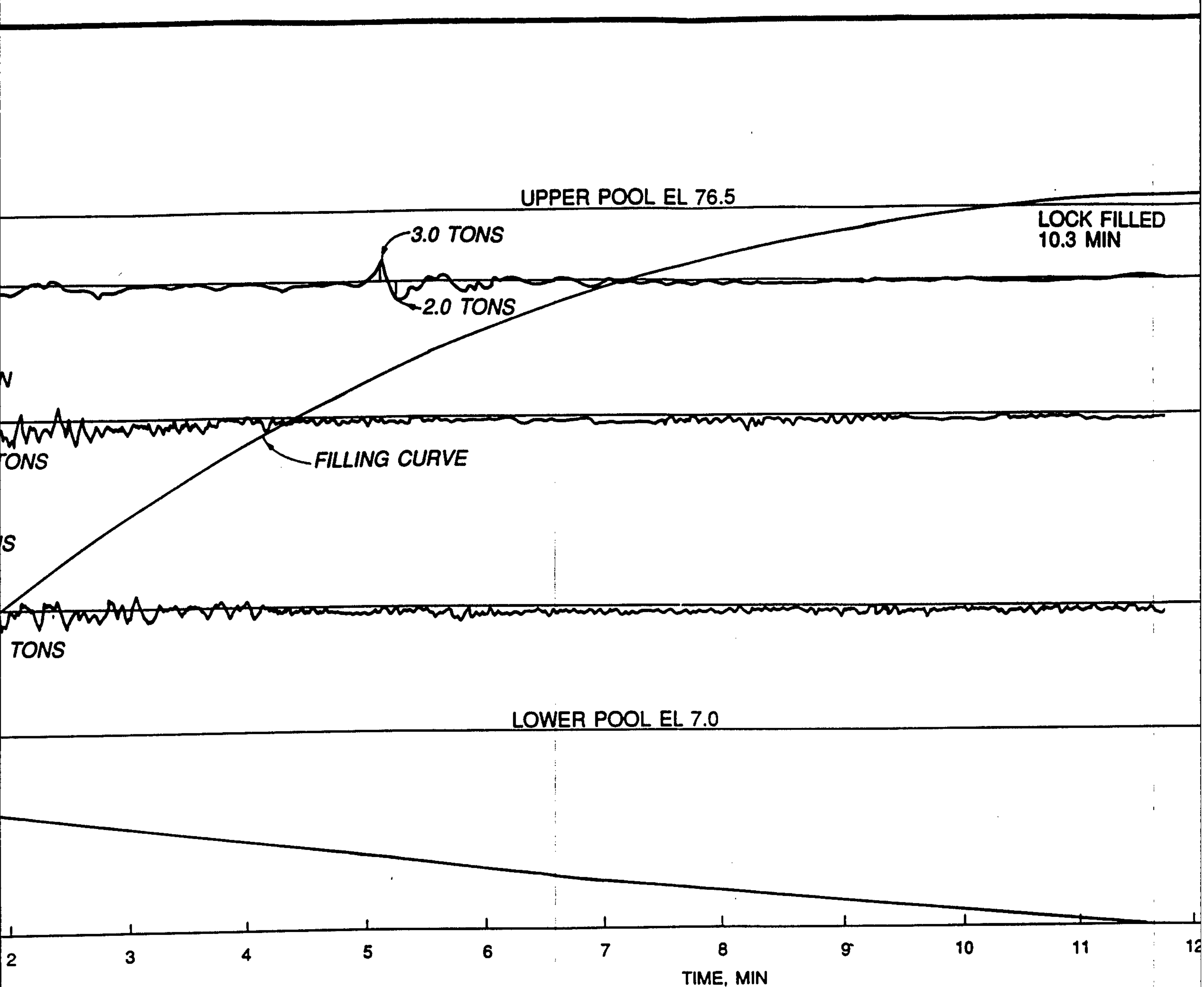
H PATTERN SYSTEM
MAXIMUM HAWSER FORCES
DURING EMPTYING OPERATIONS
TYPE 14 DESIGN
69.5-FT LIFT
U.P. 76.5, L.P.7.0



NOTE: 69.5-FT LIFT
(UPPER POOL EL 76.5,
LOWER POOL EL 7.0)

6-BARGE TOW (TOW POSITION

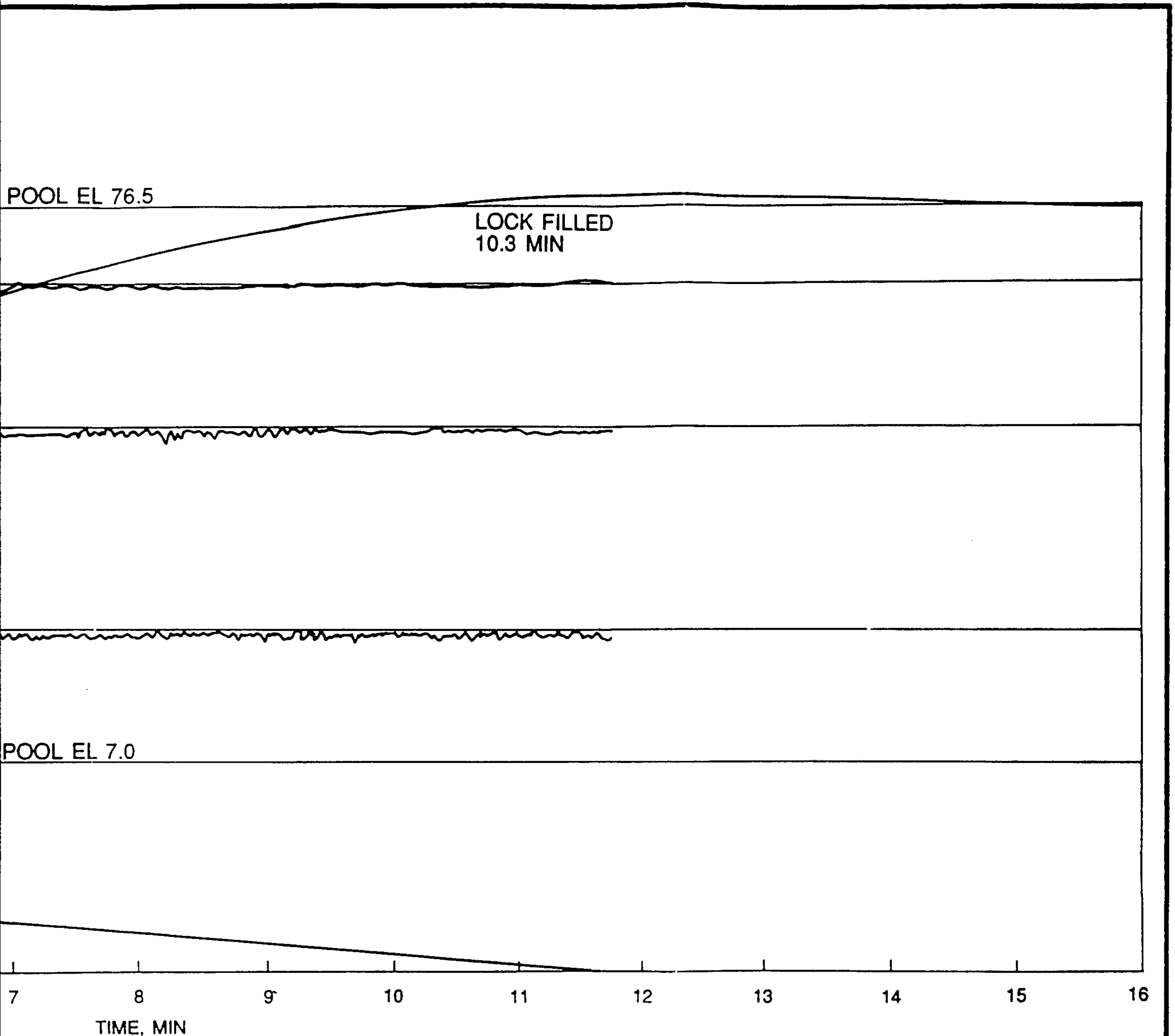
14-FT DRAFT



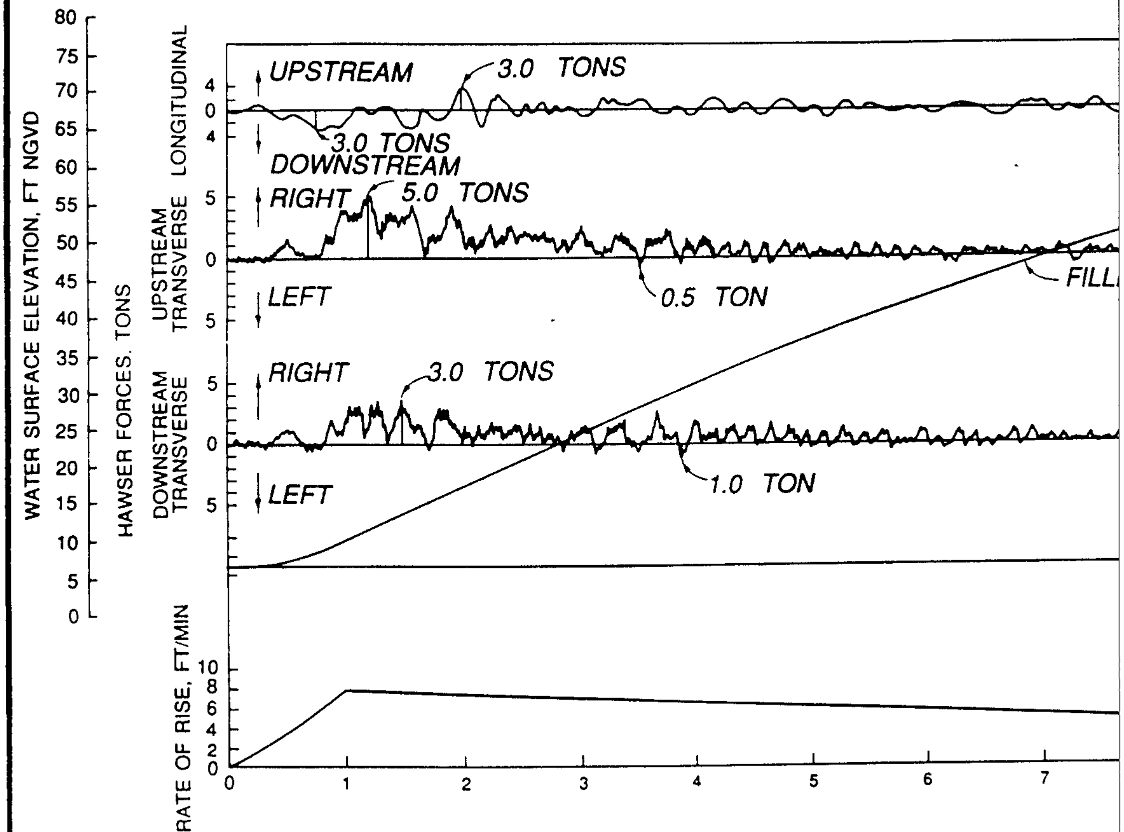
NOTE: 69.5-FT LIFT
(UPPER POOL EL 76.5,
LOWER POOL EL 7.0)

6-BARGE TOW (TOW POSITION 1)

14-FT DRAFT



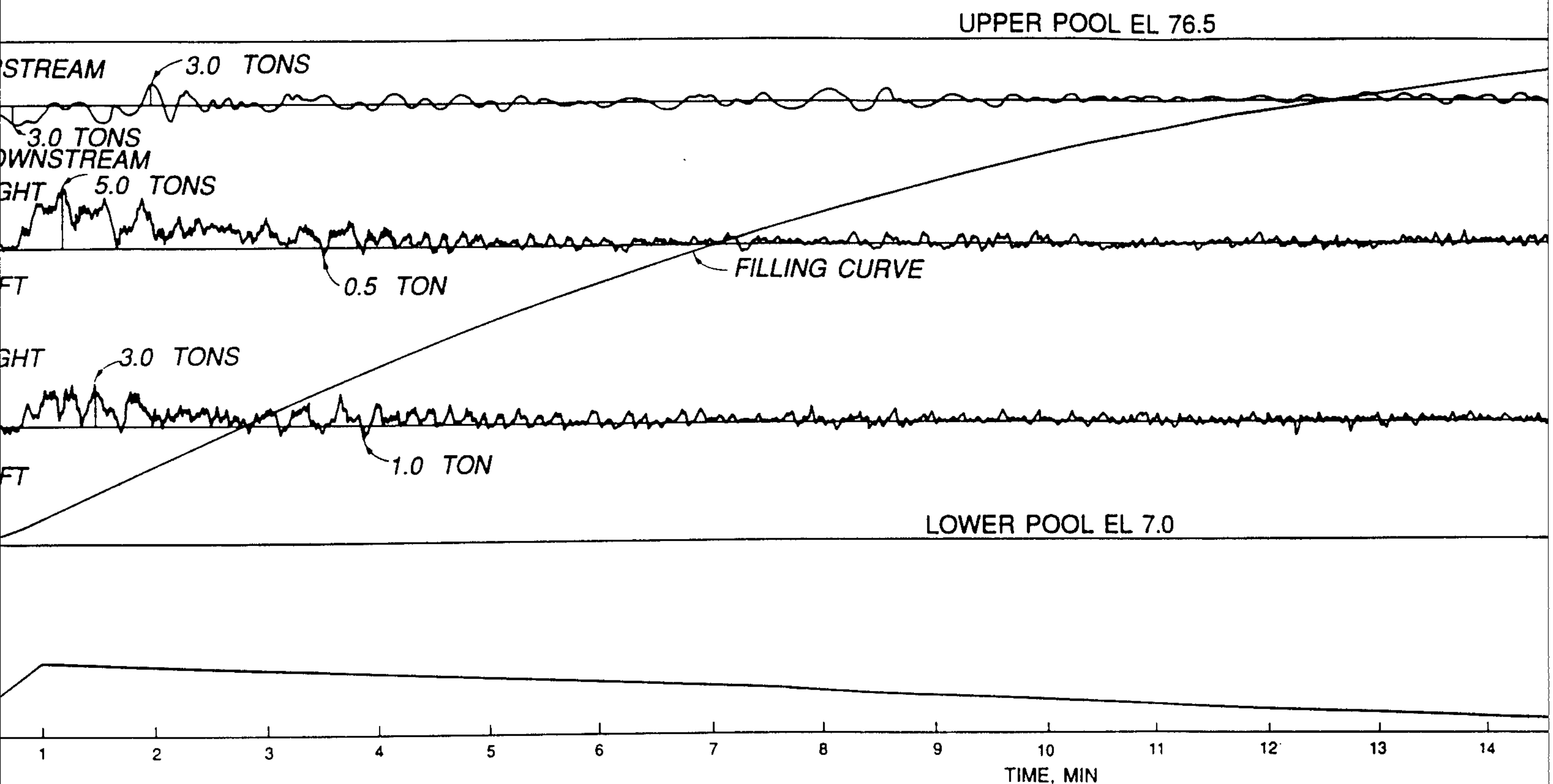
H PATTERN SYSTEM
FILLING CHARACTERISTICS
TYPE 14 DESIGN
1-MIN NORMAL VALVE



NOTE: 69.5-FT LIFT
(UPPER POOL EL 7
LOWER POOL EL 7

6-BARGE TOW (TO

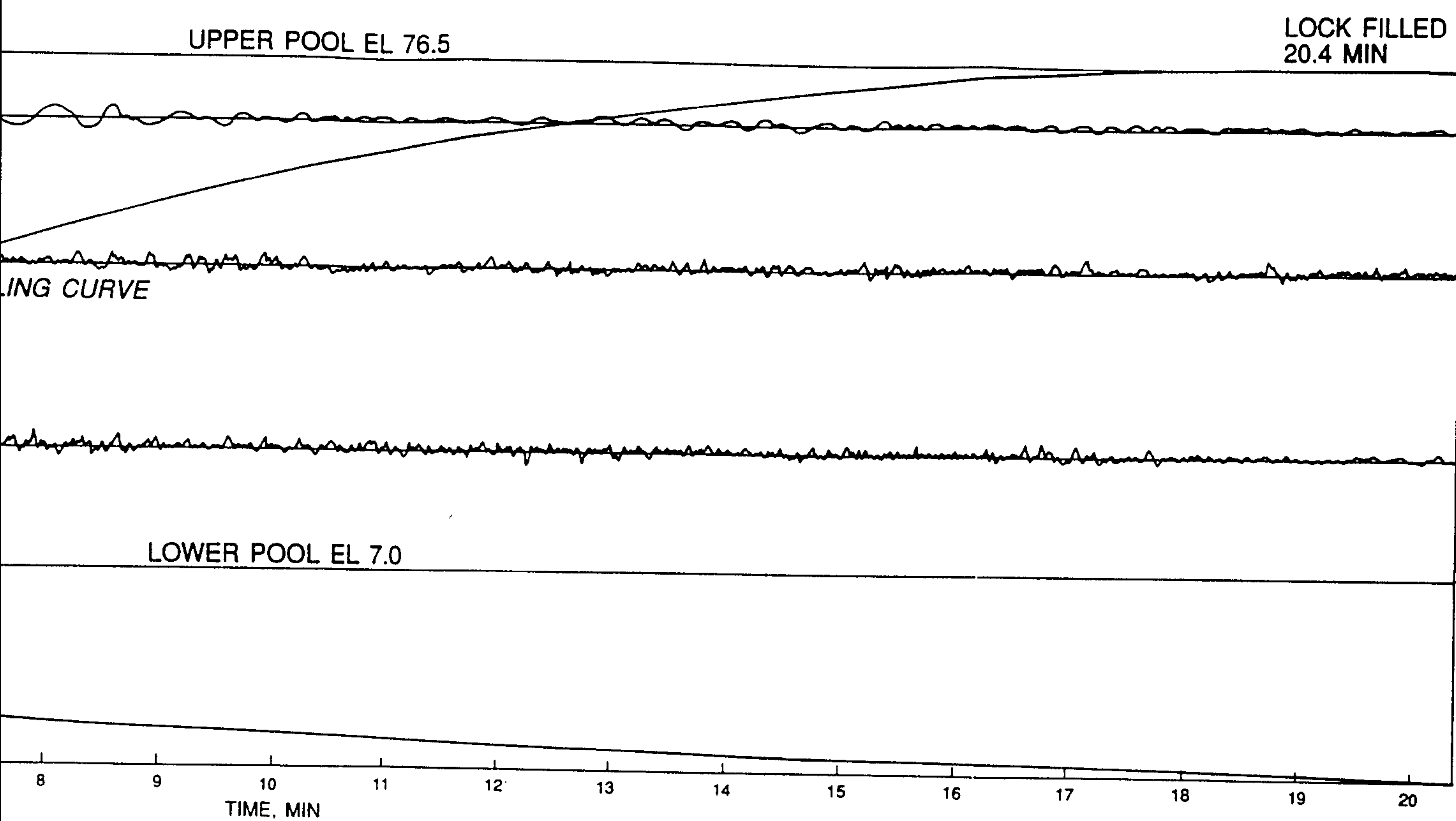
14-FT DRAFT



NOTE: 69.5-FT LIFT
(UPPER POOL EL 76.5,
LOWER POOL EL 7.0)

6-BARGE TOW (TOW POSITION 1)

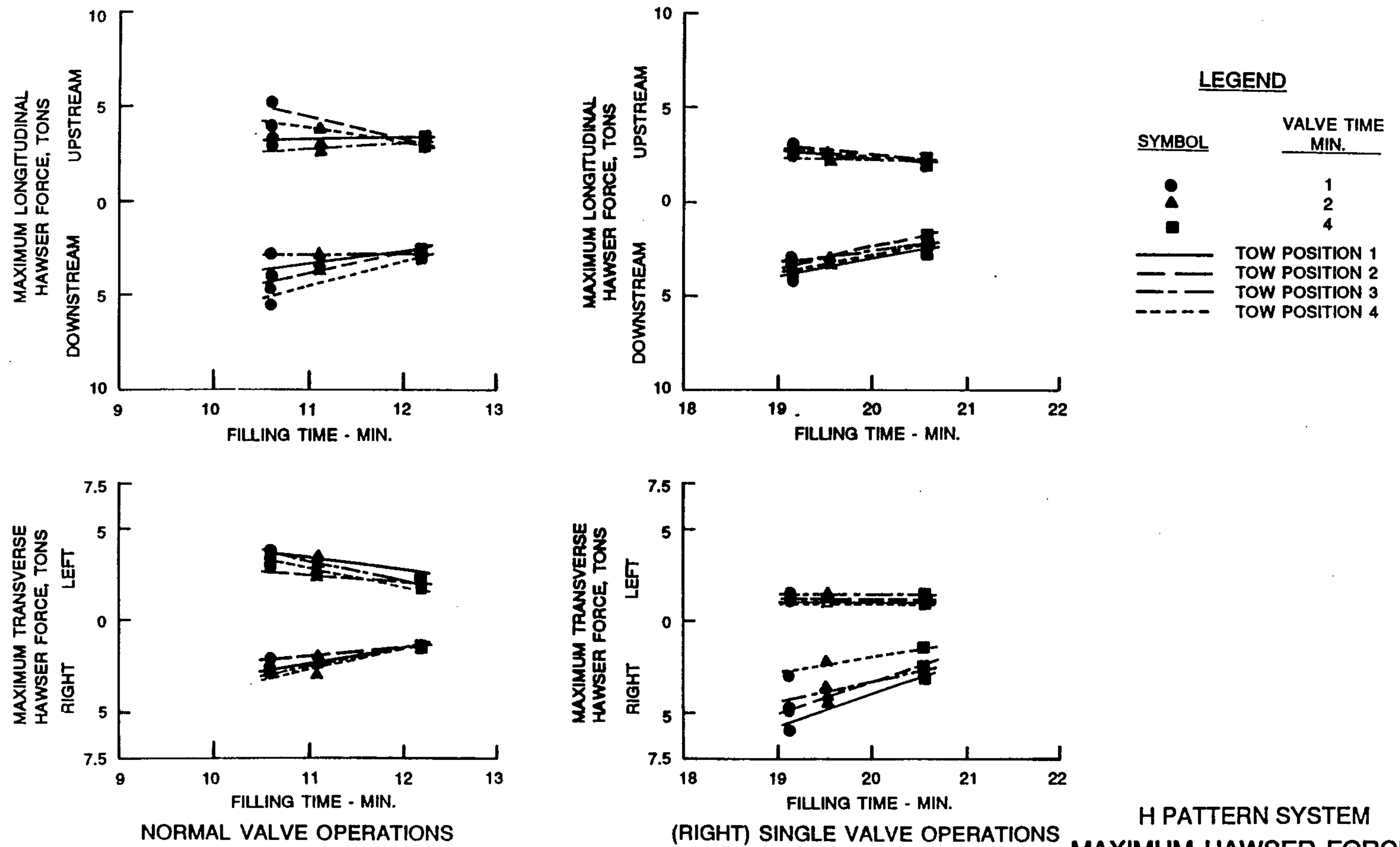
14-FT DRAFT



76.5,
.0)

W POSITION 1)

H PATTERN SYSTEM
FILLING CHARACTERISTICS
TYPE 14 DESIGN
1-MIN RIGHT SINGLE VALVE



H PATTERN SYSTEM
MAXIMUM HAWSER FORCES
DURING FILLING OPERATIONS
TYPE 14 DESIGN

71.5-FT LIFT
U.P. 76.5, L.P.5.0

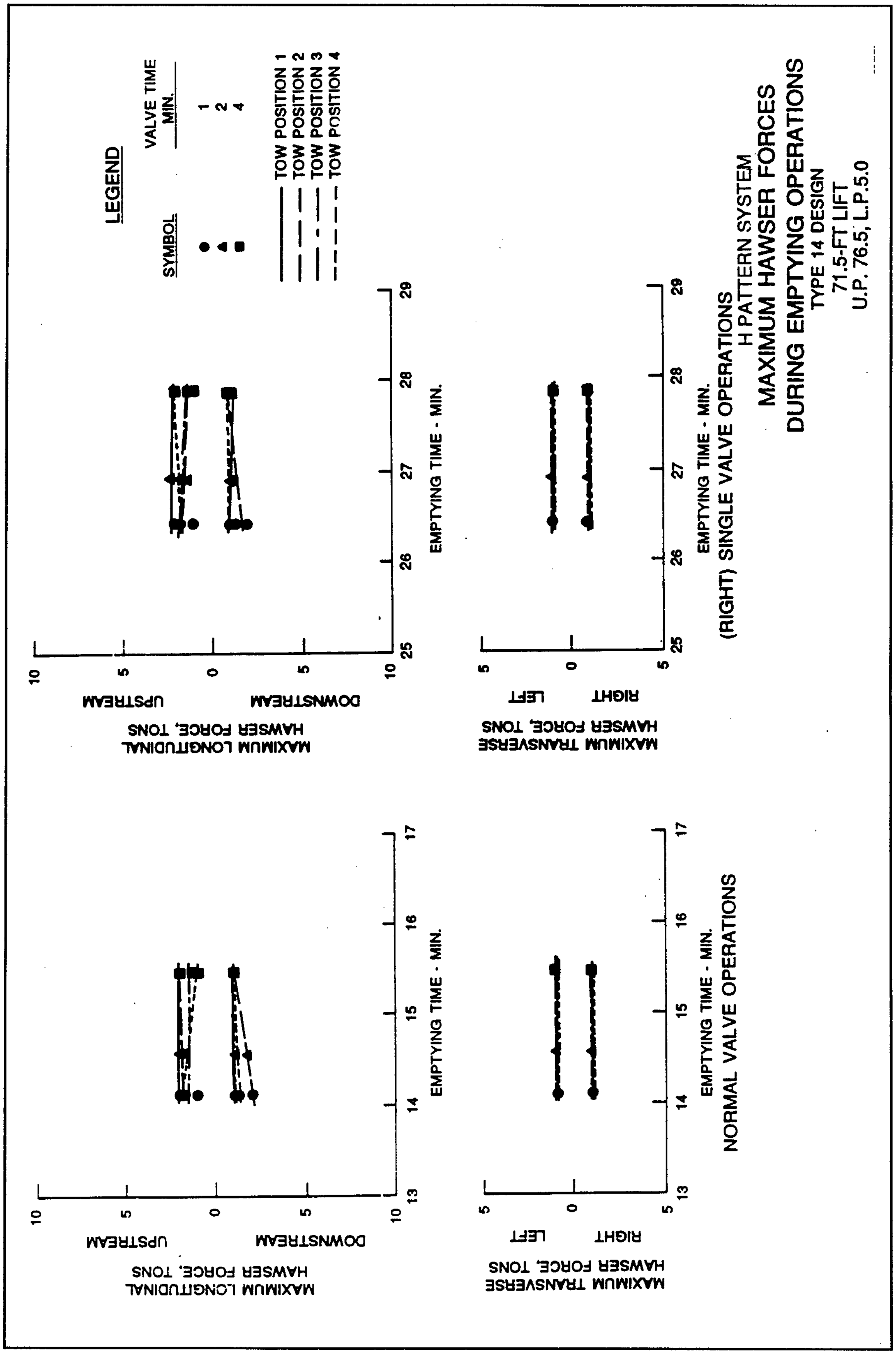
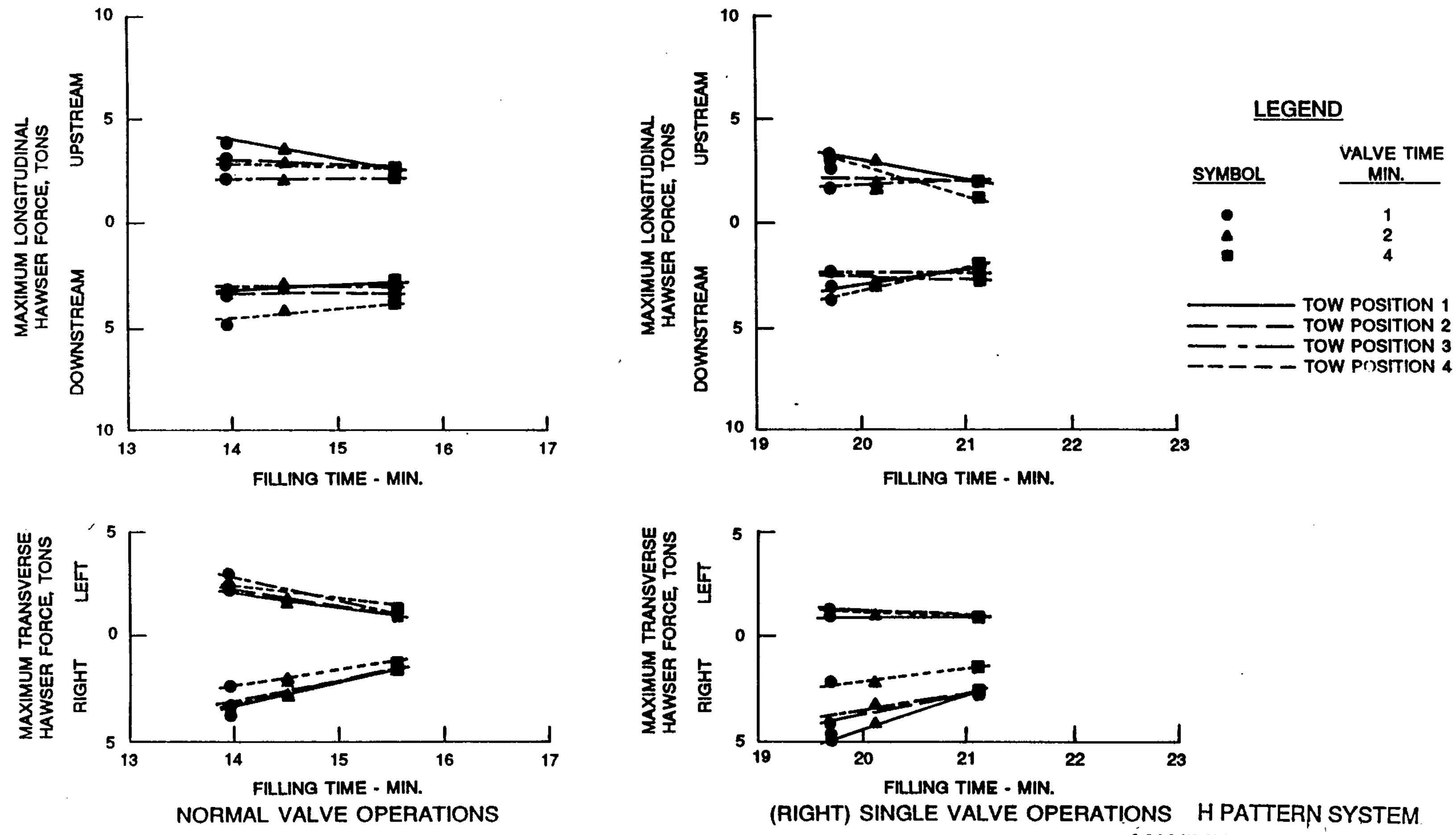
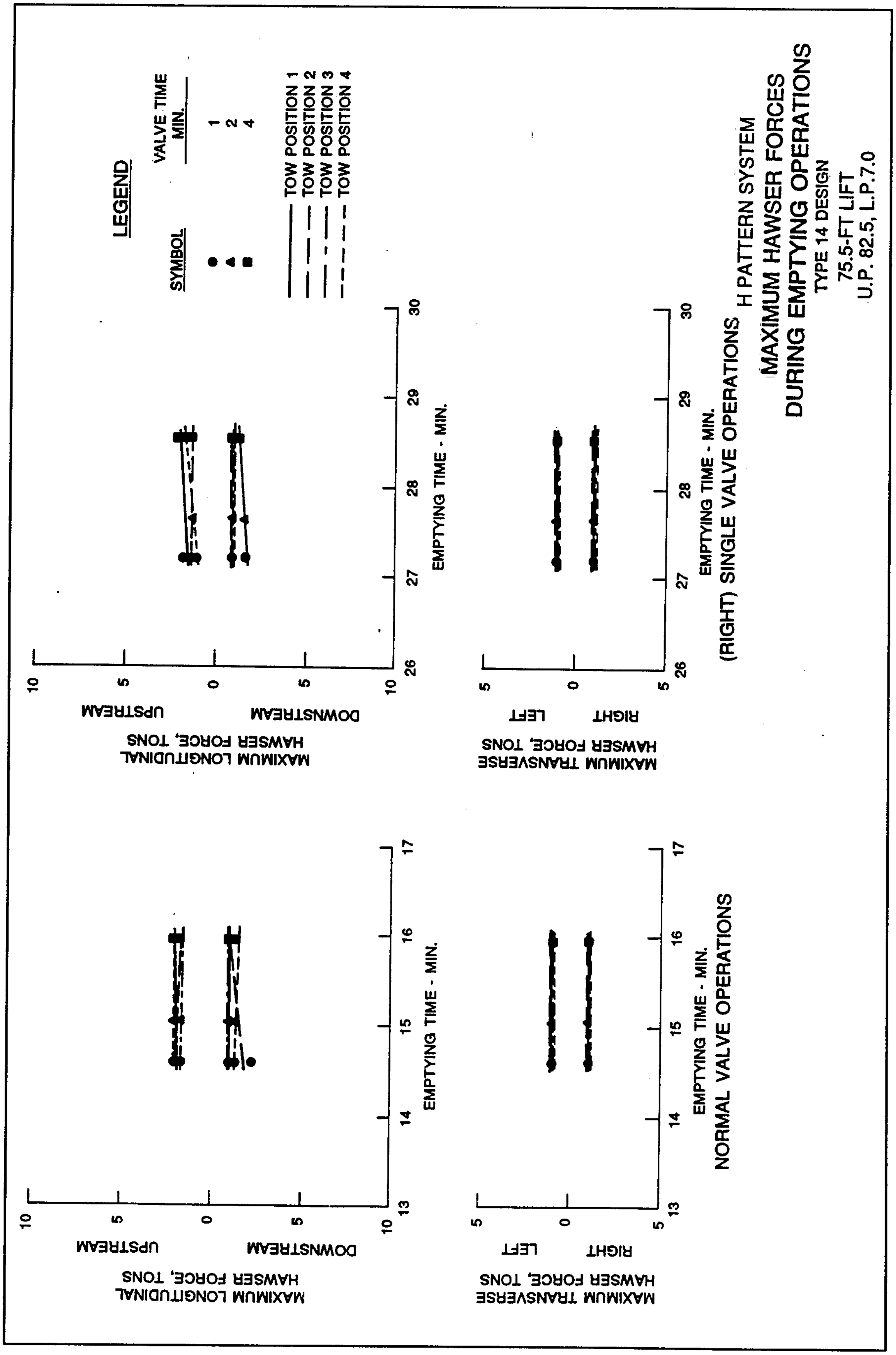

LEGEND
SYMBOL
VALVE TIME MIN.
1
2
4
TOW POSITION 1
TOW POSITION 2
TOW POSITION 3
TOW POSITION 4
MAXIMUM LONGITUDINAL HAWSER FORCE, TONS
UPSTREAM
DOWNSTREAM
MAXIMUM TRANSVERSE HAWSER FORCE, TONS
LEFT
RIGHT
EMPTYING TIME - MIN.
NORMAL VALVE OPERATIONS
(RIGHT) SINGLE VALVE OPERATIONS
H PATTERN SYSTEM
MAXIMUM HAWSER FORCES
DURING EMPTYING OPERATIONS
TYPE 14 DESIGN
71.5-FT LIFT
U.P. 76.5; L.P. 5.0

Plate 65

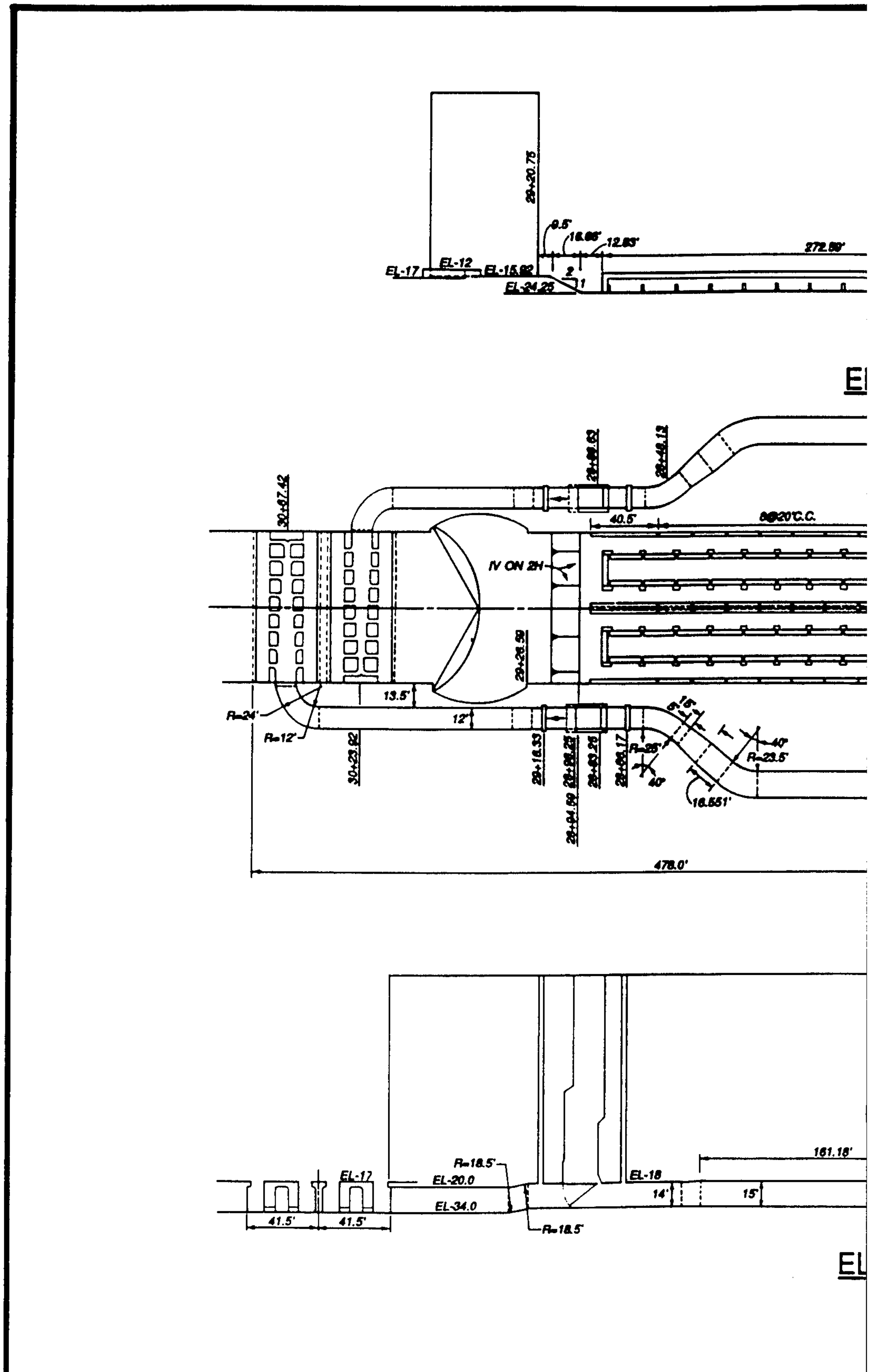


H PATTERN SYSTEM
MAXIMUM HAWSER FORCES
DURING FILLING OPERATIONS
TYPE 14 DESIGN
75.5-FT LIFT
U.P. 82.5, L.P.7.0



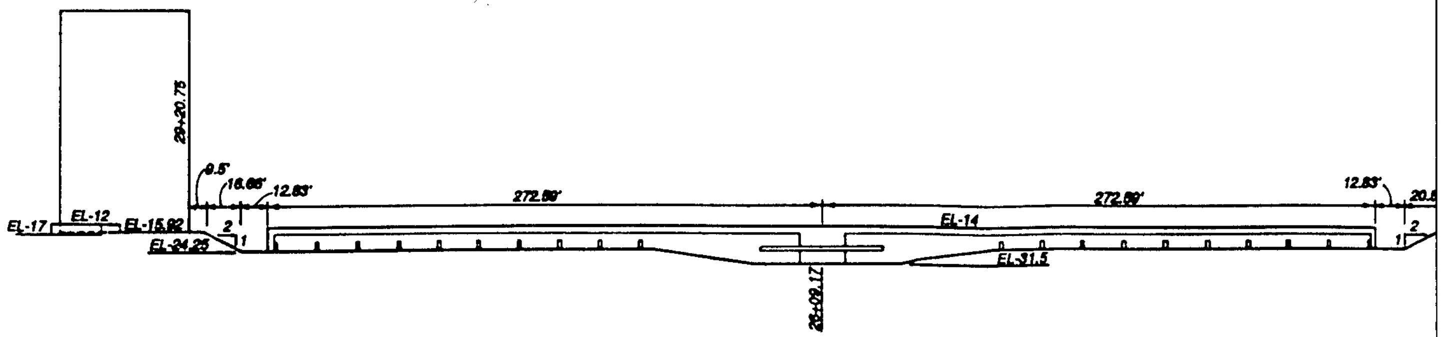
H PATTERN SYSTEM
MAXIMUM HAWSER FORCES
DURING EMPTYING OPERATIONS
TYPE 14 DESIGN
75.5-FT LIFT
U.P. 82.5, L.P.7.0

Plate 67

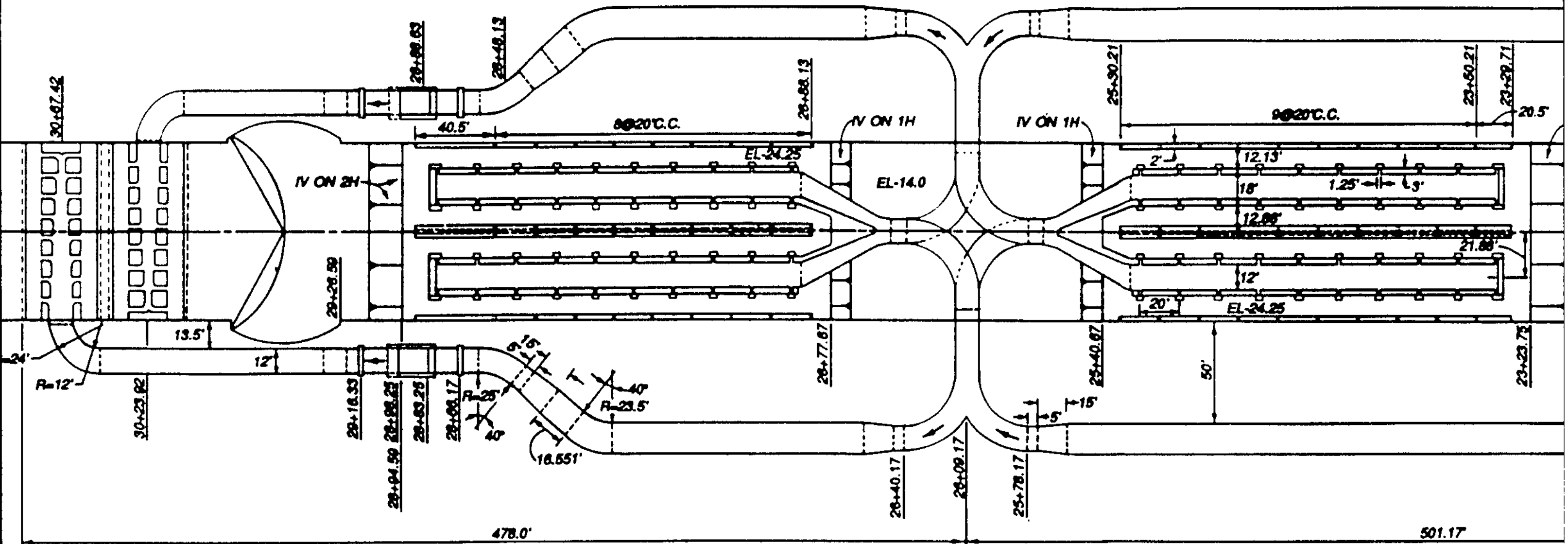


29+20.75
9.5'
16.66'
12.83'
272.89'
EL-17
EL-12
EL-15.92
EL-24.25
EL
30+67.42
29+89.63
29+49.13
40.5'
8@20'C.C.
IV ON 2H
29+26.59
13.5'
12'
R=24'
R=12'
30+23.92
29+18.33
29+94.59
15'
40'
R=23.5'
R=25'
16.551'
478.0'
161.18'
R=18.5'
EL-20.0
EL-34.0
EL-18
14'
15'
41.5'
41.5'

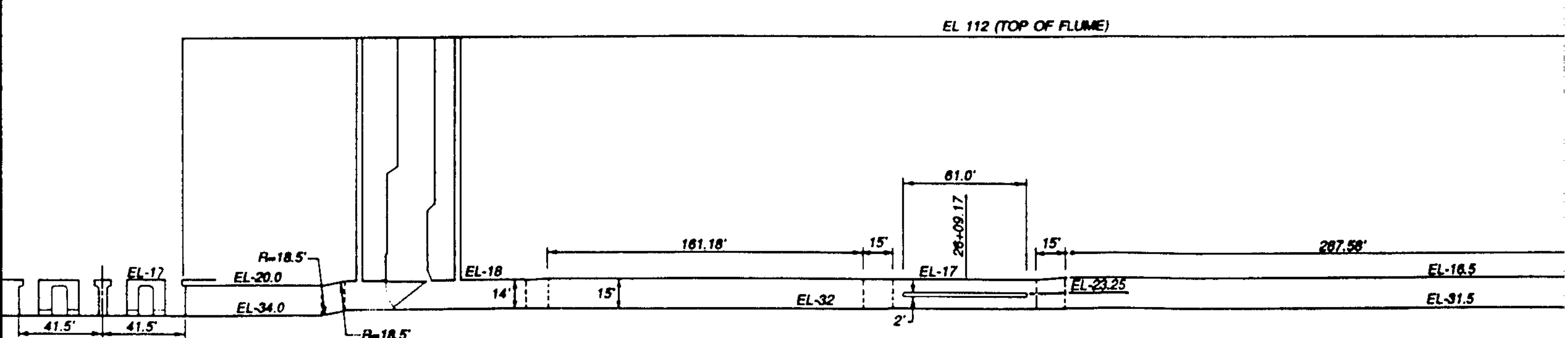
230



ELEVATION INTERIOR CULVERT

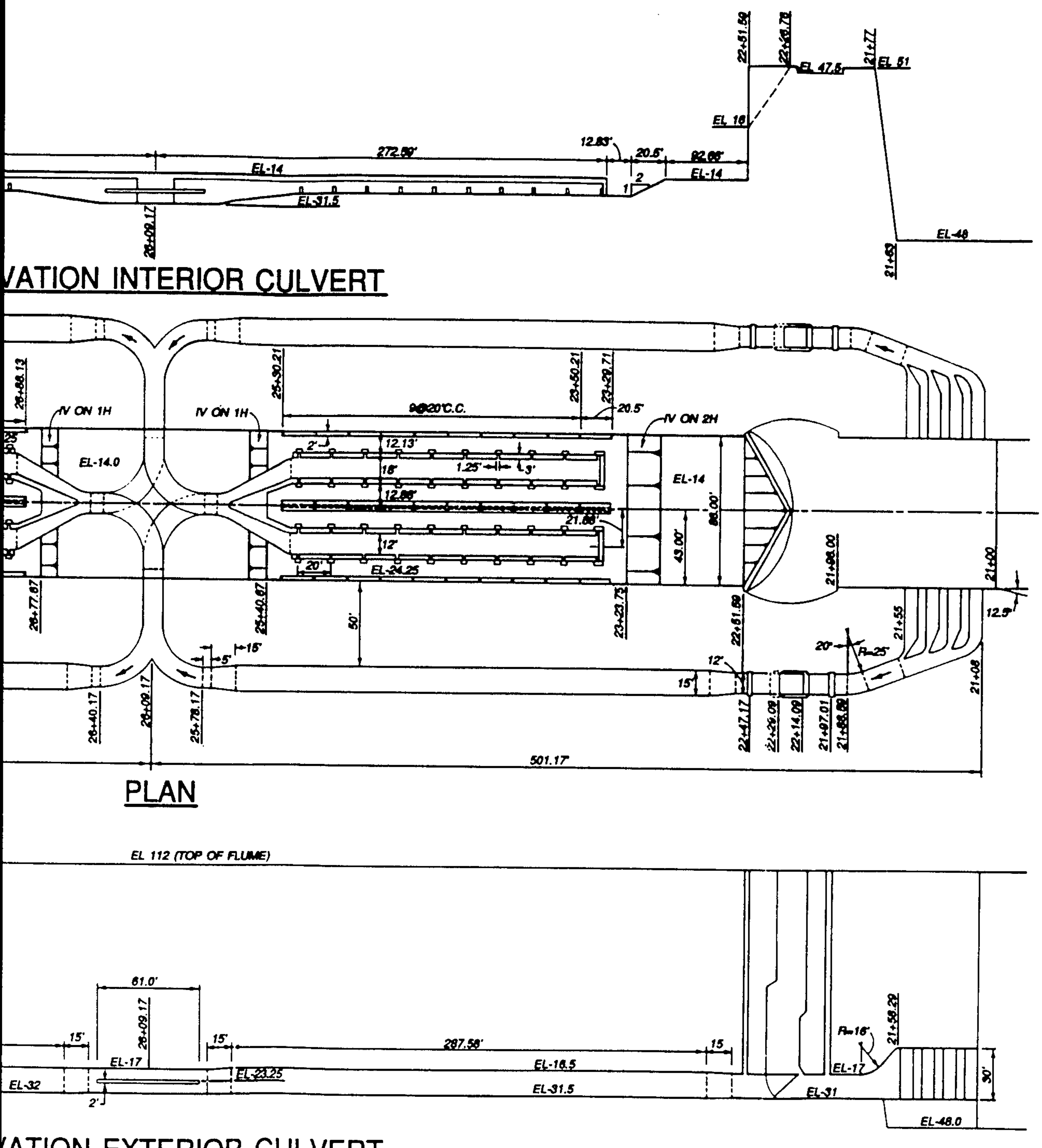


PLAN

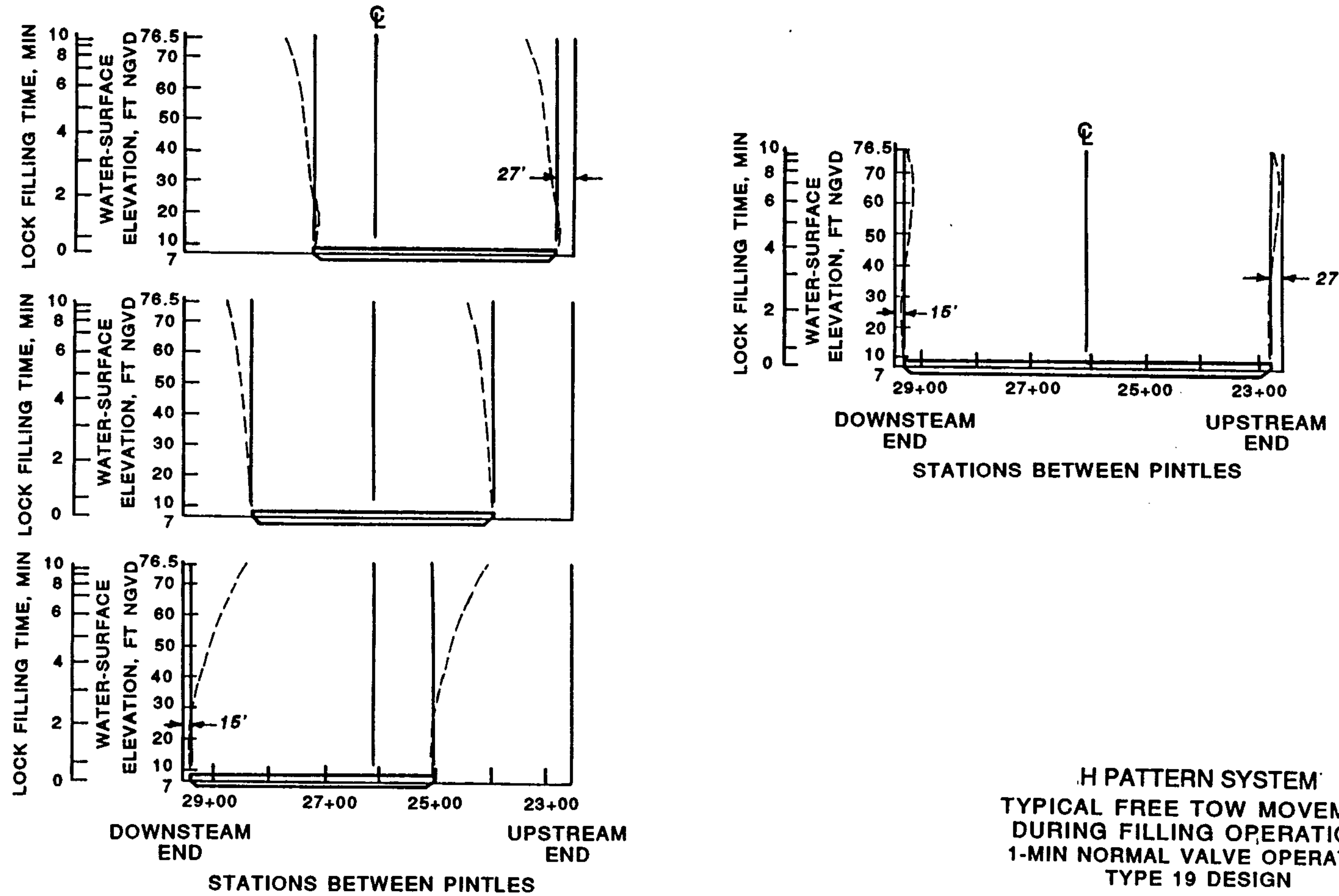


ELEVATION EXTERIOR CULVERT

FILL

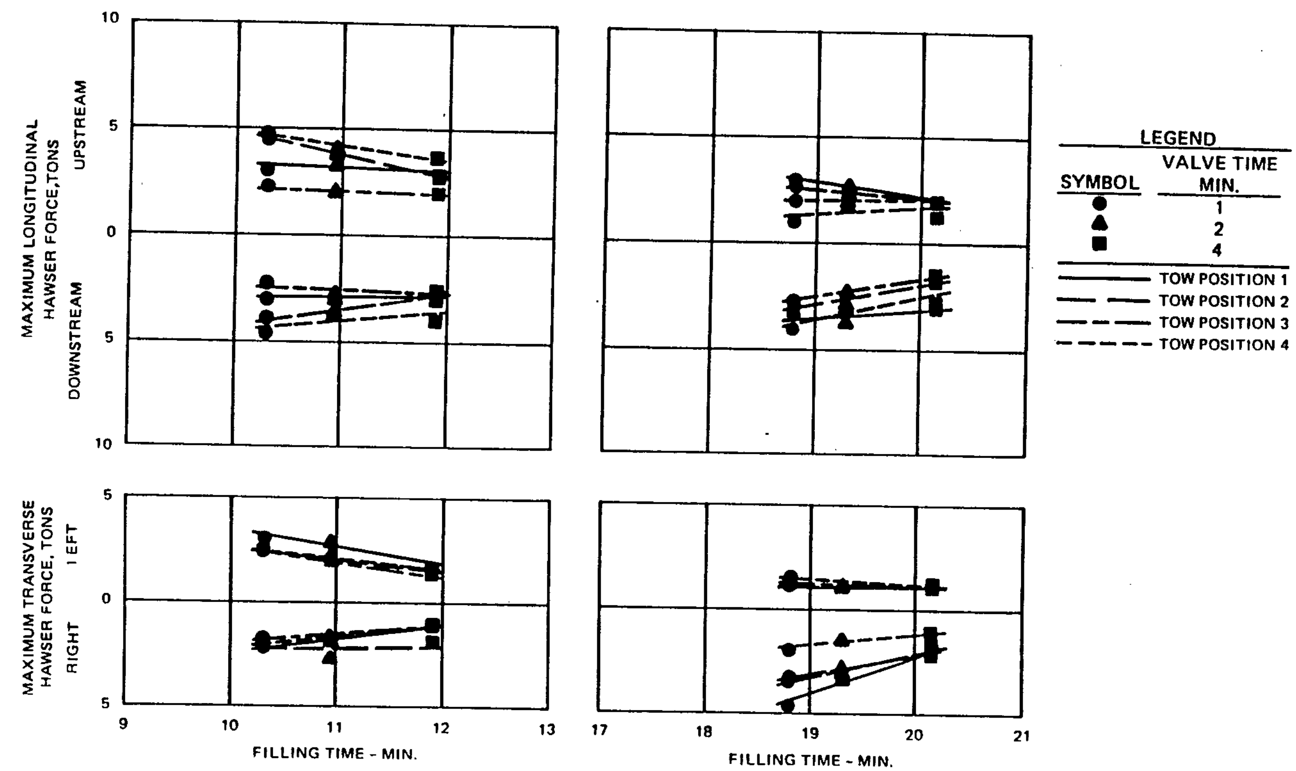


H PATTERN SYSTEM
FILLING & EMPTYING SYSTEM
TYPE 19 DESIGN



H PATTERN SYSTEM

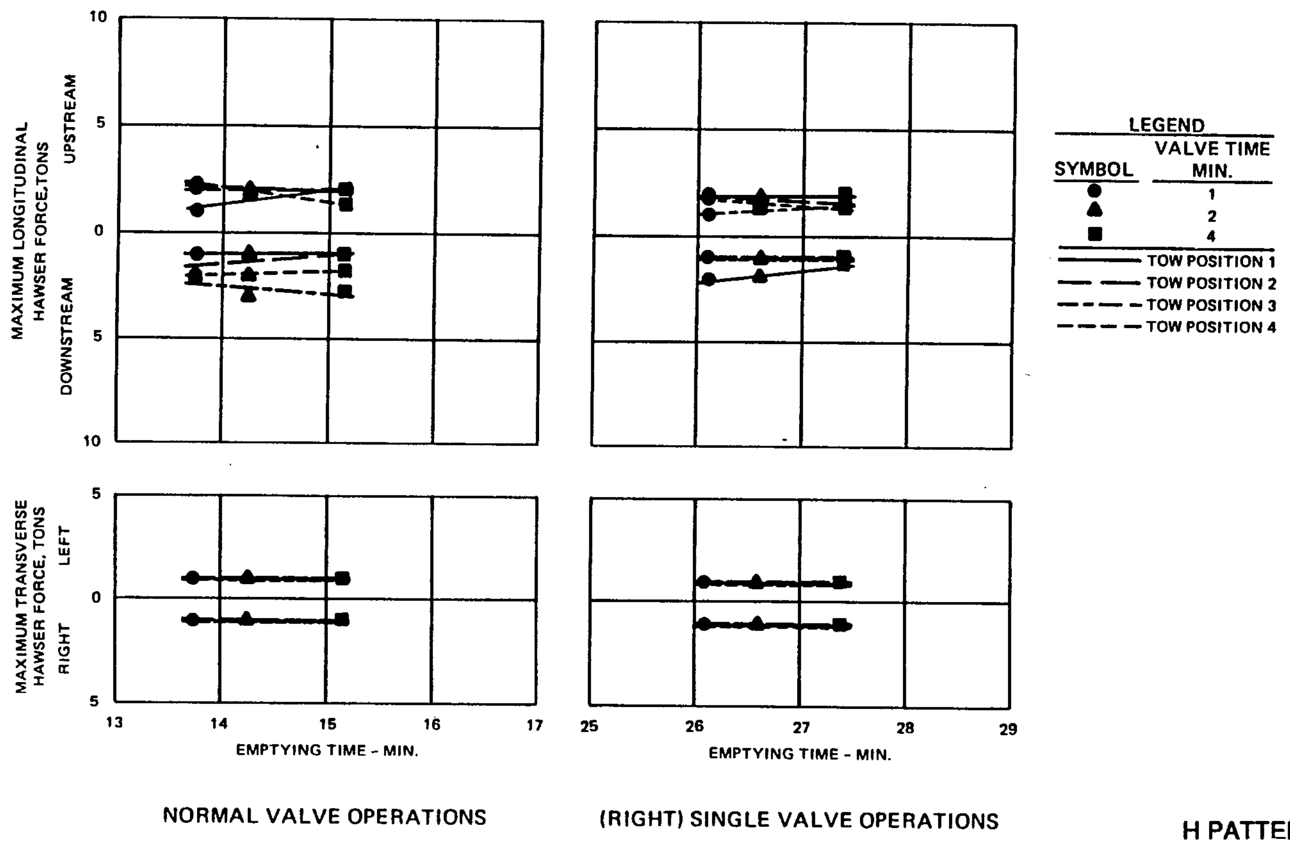
TYPICAL FREE TOW MOVEMENT
DURING FILLING OPERATIONS
1-MIN NORMAL VALVE OPERATION
TYPE 19 DESIGN



NORMAL VALVE OPERATIONS

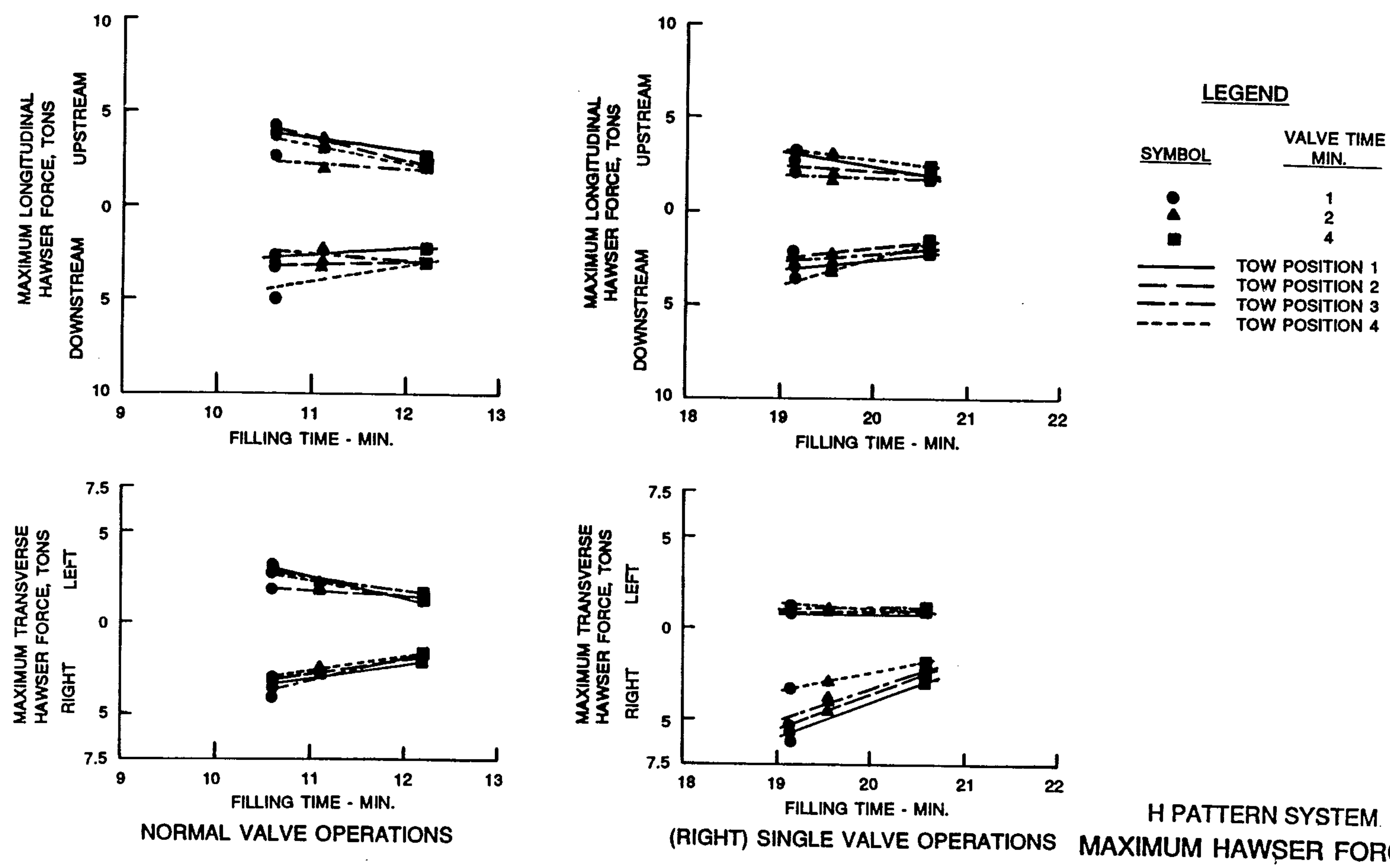
(RIGHT) SINGLE VALVE OPERATIONS

H PATTERN SYSTEM
MAXIMUM HAWSER FORCES
DURING FILLING OPERATIONS
TYPE 19 DESIGN
69.5-FT LIFT
U.P. 76.5
L.P. 7.0

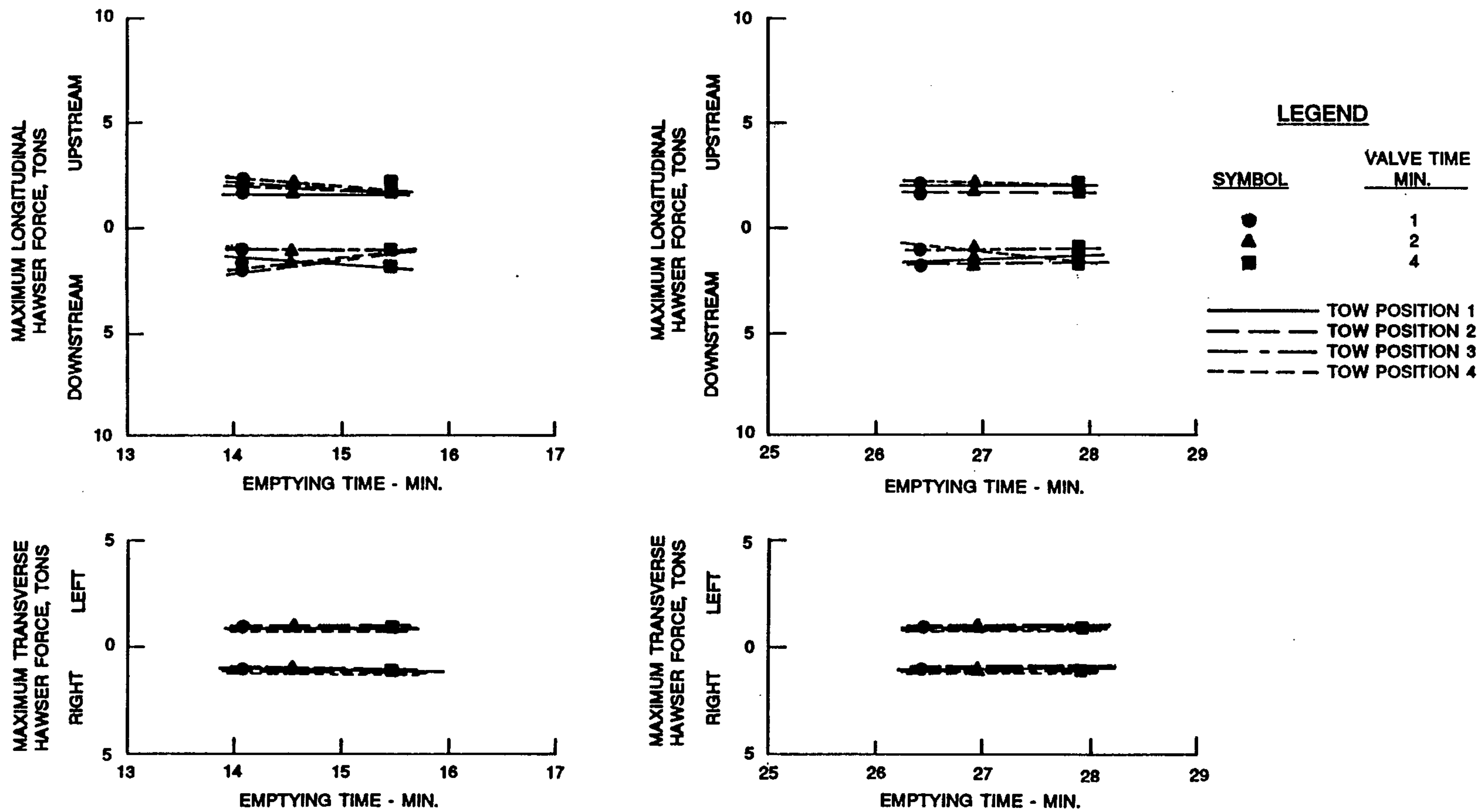


H PATTERN SYSTEM

MAXIMUM HAWSER FORCES
DURING EMPTYING OPERATIONS
TYPE 19 DESIGN
69.5-FT LIFT
U.P. 76.5
L.P. 7.0



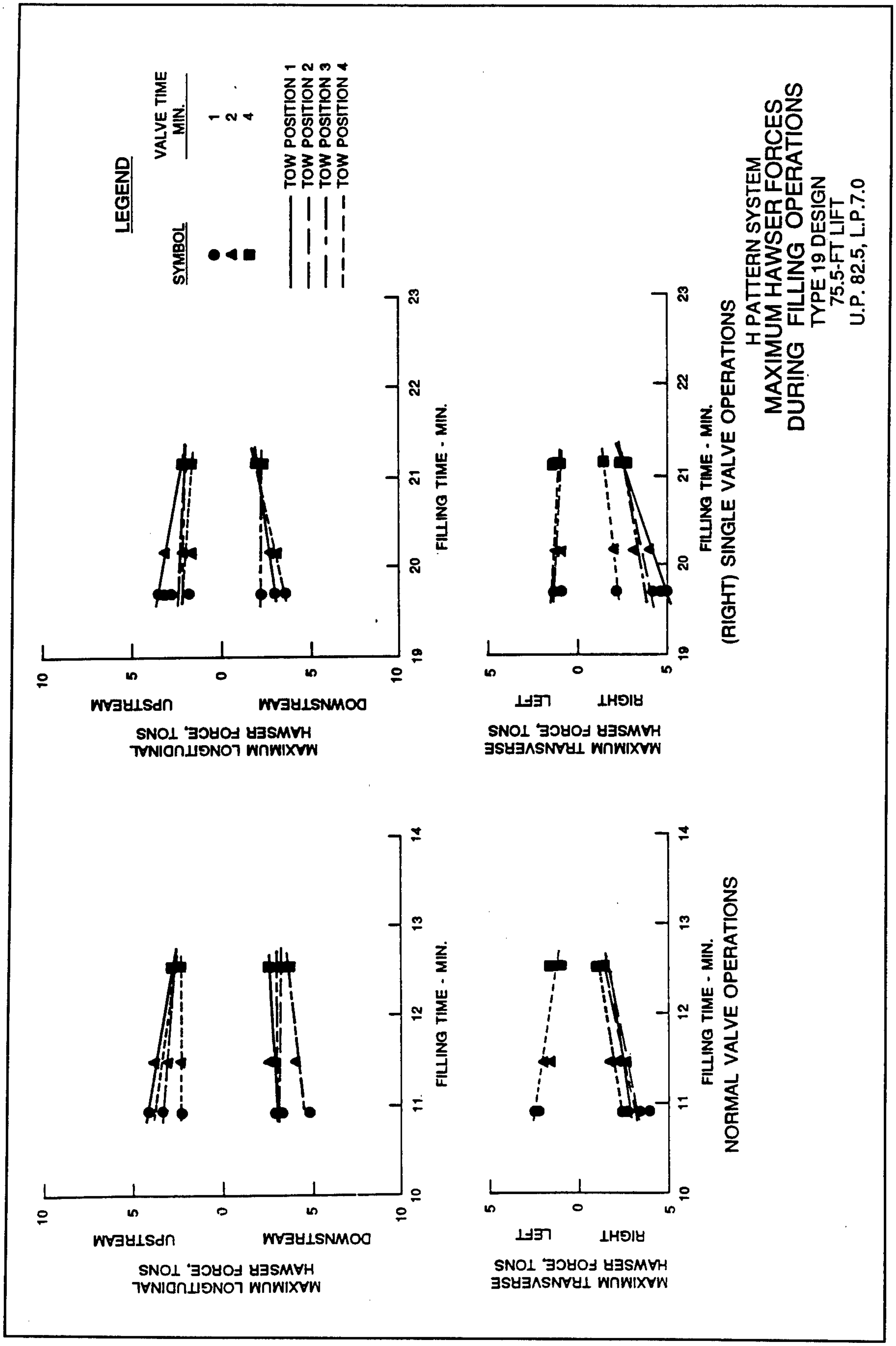
H PATTERN SYSTEM
MAXIMUM HAWSER FORCES
DURING FILLING OPERATIONS
TYPE 19 DESIGN
71.5-FT LIFT
U.P. 76.5, L.P.7.0



NORMAL VALVE OPERATIONS

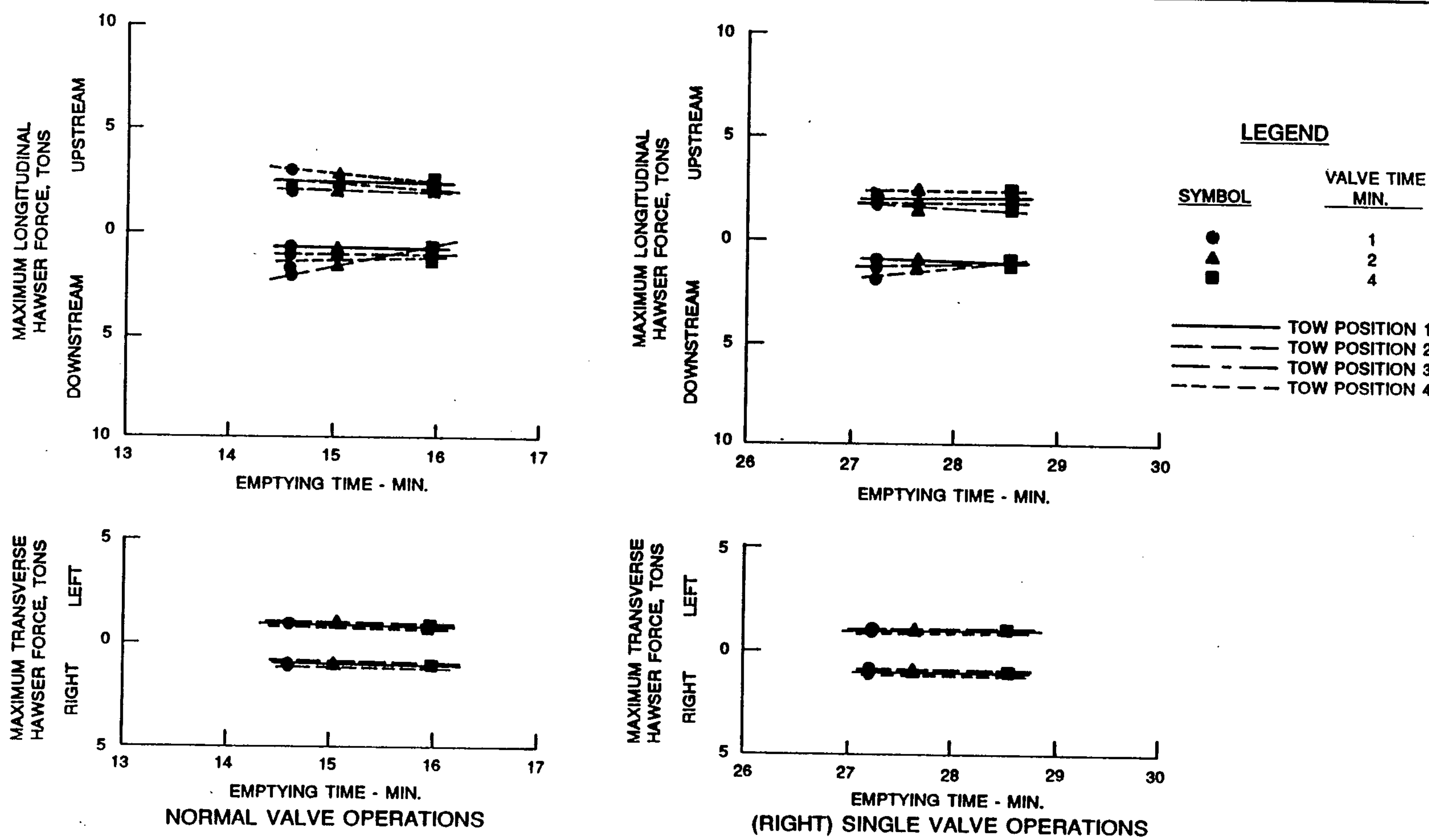
(RIGHT) SINGLE VALVE OPERATIONS

H PATTERN SYSTEM
MAXIMUM HAWSER FORCES
DURING EMPYTING OPERATIONS
TYPE 19 DESIGN
71.5-FT LIFT
U.P. 76.5, L.P.7.0

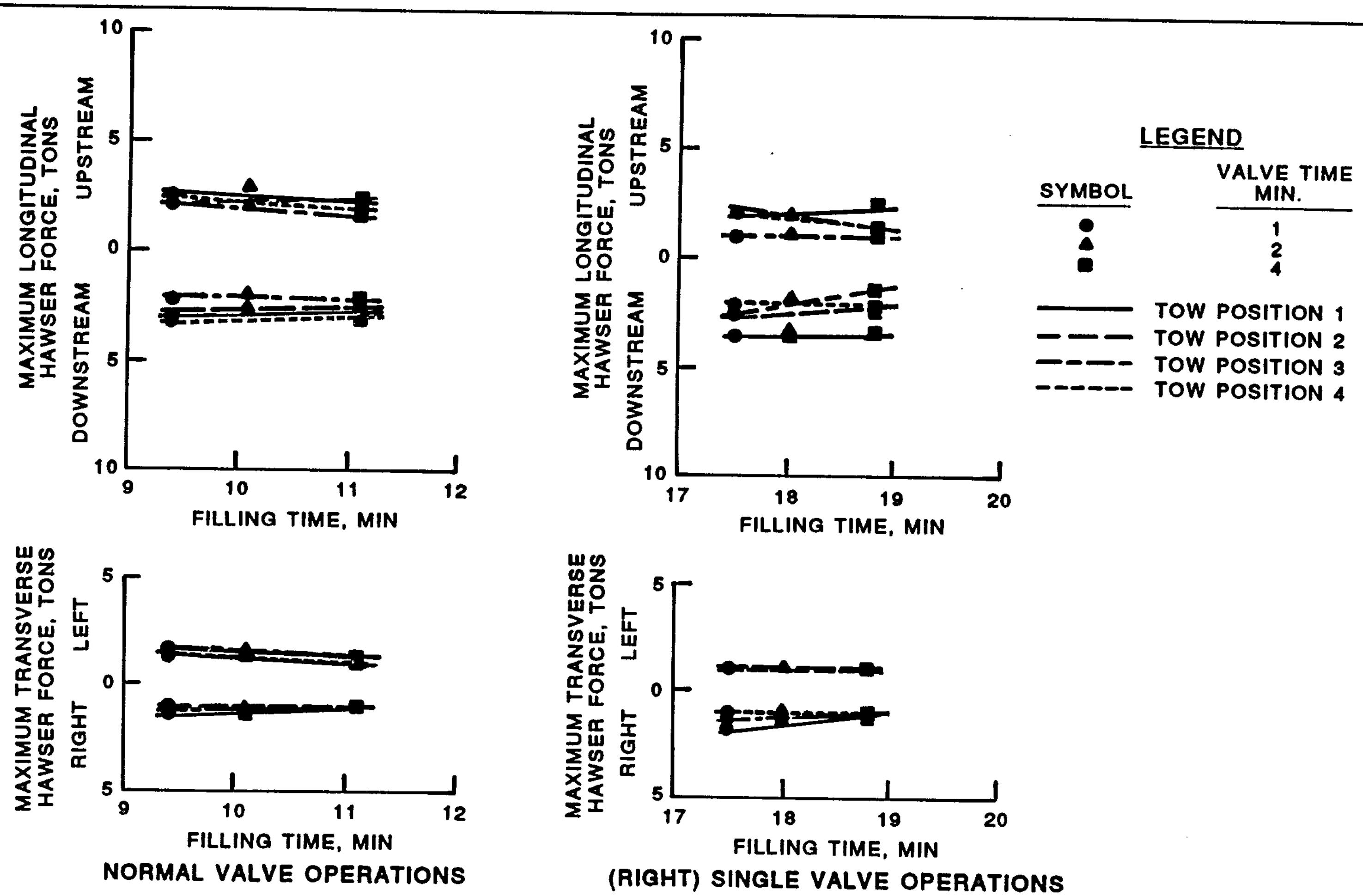


LEGEND
SYMBOL
VALUE TIME MIN.
1
2
4
TOW POSITION 1
TOW POSITION 2
TOW POSITION 3
TOW POSITION 4
MAXIMUM LONGITUDINAL HAWSER FORCE, TONS
UPSTREAM
DOWNSTREAM
MAXIMUM TRANSVERSE HAWSER FORCE, TONS
LEFT
RIGHT
FILLING TIME - MIN.
NORMAL VALVE OPERATIONS
(RIGHT) SINGLE VALVE OPERATIONS
H PATTERN SYSTEM
MAXIMUM HAWSER FORCES
DURING FILLING OPERATIONS
TYPE 19 DESIGN
75.5-FT LIFT
U.P. 82.5, L.P.7.0

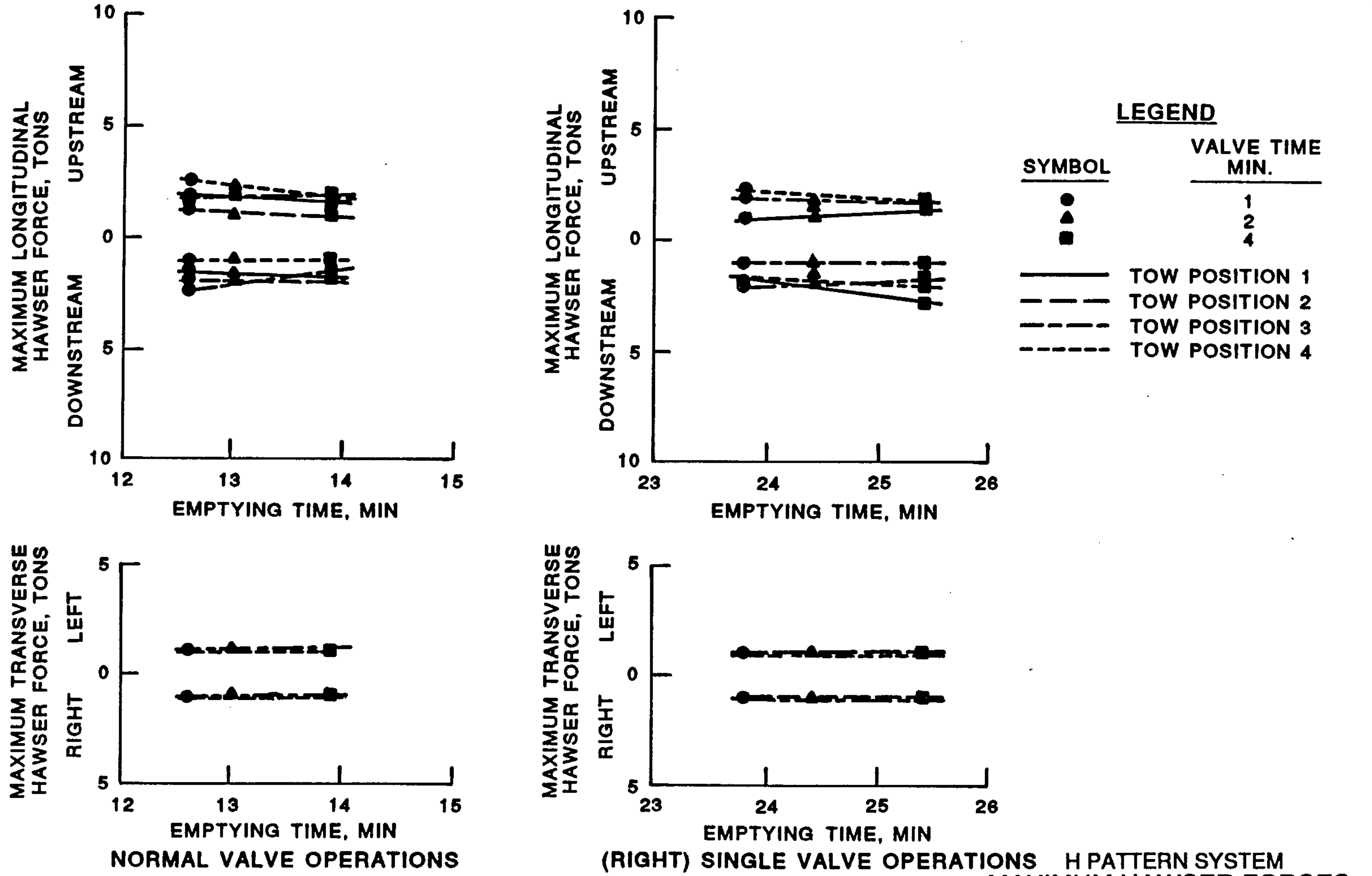
Plate 74



H PATTERN SYSTEM
MAXIMUM HAWSER FORCES
DURING EMPTYING OPERATIONS
TYPE 19 DESIGN
75.5-FT LIFT
U.P. 82.5, L.P.7.0



H PATTERN SYSTEM
MAXIMUM HAWSER FORCES
DURING FILLING OPERATIONS
TYPE 19 DESIGN
58.0-FT LIFT
U.P. 74.0, L.P.16.0



H PATTERN SYSTEM
MAXIMUM HAWSER FORCES
DURING EMPTYING OPERATIONS
TYPE 19 DESIGN
58.0-FT LIFT
U.P. 74.0, L.P.16.0

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY ***(Leave blank)***

2. REPORT DATE
September 1996

3. REPORT TYPE AND DATES COVERED
Final report

4. TITLE AND SUBTITLE
Navigation Lock for Bonneville Dam, Columbia River, Oregon; Volume I: Main Text; Volume II: Appendix A, Pressures During Lock Operations

5. FUNDING NUMBERS

6. AUTHOR(S)
Richard L. Stockstill, John F. George

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
U.S. Army Engineer Waterways Experiment Station
3909 Halls Ferry Road, Vicksburg, MS 39180-6199

8. PERFORMING ORGANIZATION REPORT NUMBER
Technical Report HL-96-13

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Army Engineer District, Portland
P.O. Box 2946, Portland, OR 97208-2946

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES
A limited number of copies of Appendix A were published under separate cover. Copies of this report and Appendix A are available from National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161.

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

12b. DISTRIBUTION CODE

13. ABSTRACT ***(Maximum 200 words)***

Tests were conducted on two different 1:25-scale models of the New Bonneville Lock located on the Columbia River in Oregon. The lock models were built to study the filling and emptying systems, which consisted of designs utilizing bottom longitudinal floor culverts. The first design studied, defined as the H-H pattern system, consisted of four longitudinal flood culverts in each end of the lock chamber. The second system studied had two longitudinal floor culverts in each end of the lock chamber and was defined as the H pattern system.

In the H-H pattern system, the filling culverts, which were located under the lock chamber floor, connected to a crossover culvert with a horizontal splitter wall dividing the flow to upstream and downstream splitter manifolds were equal divisions led into four longitudinal flood culverts in each end of the lock chamber. With the type 6 (recommended) design and a 1-min valve opening time, the lock chamber filled in 8.7 min and emptied in 12.1 min. Due to differences in friction losses, the prototype can be expected to fill and empty about 20 percent faster than the model (7.0 min and 9.7 min, respectively). Modifications involving installing a slope in the lower sill and a v-notch design in the high sill were significant factors that resulted in fast filling and emptying times, low hawser forces, and only minor movement with various tow arrangements for different operating scenarios.

(Continued)

14. SUBJECT TERMS

Bonneville Lock	Hydraulic models
Columbia River (OR)	Locks

15. NUMBER OF PAGES
Vol I - 179, Vol II - 218

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED		

13. (Concluded).

In the H pattern system, the culverts outside the lock walls connected to a crossover culvert with a horizontal splitter wall dividing the flow to upstream and downstream tuning forks where equal divisions led into the two longitudinal floor culverts in each end of the lock chamber. With the type 36 (recommended) design, upstream approach flow conditions in the vicinity of the intakes were satisfactory and vortex-free. With the type 14 (recommended) design filling and emptying system and a 1-min valve opening time, the lock chamber filled in 10.3 min and emptied in 13.8 min. The development of the type 14 design is summarized in the chart on page 30. Due to differences in friction losses, the prototype can be expected to fill and empty about 15 percent faster than the model (8.8 min and 11.7 min, respectively). The unsymmetrical baffling arrangement and the slope placed on the lower sill were the key factors that resulted in low hawser and minor movement of free tows during fast filling.

Both the H-H pattern and H pattern systems developed are particularly desirable for high-lift locks because they are insensitive to misoperation. That is, fast operation, nonsynchronous operaqtion, or intermittent stopping of the valves during the opening cycle does not create dangerous surges in the lock chamber.